DEPARTMENT OF THE ARMY PAMPHLET 70-5-11

MISSILES AND VENTURES INTO SPACE PROGRESS REPORT 1962-1963

HEADQUARTERS, DEPARTMENT OF THE ARMY

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ANALYSTS' NOTE

This volume will be the last of the series of DA Pamphlets begun in 1958 at the request of the Office, Chief of Research and Development, Department of the Army. This volume covers the period May 1962 to May 1963 and includes approximately 750 unclassified titles mostly abstracted and annotated and selected from periodicals, books, and studies.

The ever-increasing volume of publications on every aspect of the state-of-the-art, the growing number of projects in the United States and abroad, and the increasing complexities of the subject matter, of necessity command a high degree of selectivity.

The analysts of The Army Library endeavored to select the materials in such a manner that the bibliography would reflect, in some measure, the many areas of progress in missile science, rocket technology, and space exploration which had taken place during the past year.

While this bibliography was being readied for publication, MERCURY Astronaut, Major Leroy Gordon Cooper in Faith 7 circumnavigated the globe 22 times in some 34 hours and moved the United States to the threshold of Project GEMINI and its two-man space flight. His outstanding achievement climaxes much of the information that is included in this bibliography and pinpoints the many items of progress that loomed into prominence during the past 12 months.

The materials in the bibliography are arranged in alphabetical order by title within major and subordinate subject groups. The titles listed are for the most part available in the holdings of The Army Library, The Adjutant General's Office.

Appendixes include data on US and Soviet missiles and spacecraft. A Special Appendix presents in chronological order (from September 1962) the politico-military aspects of Soviet missiles in the Cuban crisis.

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DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *31 October 1963*

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I. UNITED STATES

A. Trends in the National Effort.

1. Miscellaneous Aspects.

AN AMERICAN ON THE MOON—A $20 BILLION BOONDOGGLE? In *U. S. News and World Report*, v. 53, no. 8 (20 Aug 1962) 52-61.

The US plan now is to send three men out to the Moon and back just five years from now, and the goal—to get there before Russia does. The question arises why we should plan for this? "Is there something on the Moon worth $20 billion dollars? Is this scientific? Military? Or is it turning into a fantastic waste of resources?" These are some of the questions being raised about America's Project APOLLO. To get expert views, staff members of U. S. News and World Report talked with leading space authorities here and abroad. Their answers "bring the Moon race into new, sharper focus." Interviews include: Aim—To Learn How World Began (interview with Dr. John A. O'Keefe, scientist, NASA); A Lunar Landing by 1970 (interview with John W. Paup, APOLLO Program Manager, North American Aviation); Man is a Nuisance in Space (interview with Dr. R. L. F. Boyd, physicist, University College, London); We're Proceeding Too Rapidly (interview with Senator William Proxmire, Wisconsin); and Defense Gains in Space (interview with Lt. Gen. James Ferguson, USAF, Deputy Chief of Staff for Research and Technology).

LET'S BE REALISTIC ABOUT THE IMPACT OF ASTRONAUTICS, by Donald N. Michael, in *Air Force*, v. 45, no. 12 (Dec 1962) 45–49.

"Space could, sadly, develop into a vast pyramid-building activity, with the public viewing it as a circus or even indifferent to its consequences—or it could produce a great new human self-awareness. Astronautical impact will depend increasingly on the skill and dedication of the teachers who guide our youth. . . ."

LONG-RANGE BALLISTIC MISSILES, by Eric Burgess. New York, Macmillan, 1962. 255 p.

The author visited facilities and installations across the United States and says: "The tremendous scope of the ballistic missile programme spreads across all states and every industry. It required an effort on a national scale greater than that needed to produce the first atomic bomb. Seeing at first hand the many facets of the programme one cannot but be impressed. I was no exception." His book describes how the missile forms part of a weapons system and how the many parts of the overall system have to be integrated into a whole and have to perform rapidly, precisely, and with great reliability. The chapters are: 1. BALLISTIC MISSILE PROGRAMME; 2. BALLISTIC MISSILE ARSENAL; 3. TRAJECTORIES; 4. VEHICLES; 5. RE-ENTRY BODIES; 6. MISSILE SUPPORT; 7. DEFENSE; 8. PLOUGHSHARES ("The ICBM, conceived as a devastating military weapon, can be harnessed to help Man reach for the stars.") Photos and illustrations.

THE SPACE AGE, in *Newsweek*, v. 60, no. 15 (8 Oct 1962) SPECIAL ISSUE.

This special issue of Newsweek contains the following articles: THE NATION AND SPACE which deals with the changing face of the United States; THE BUSINESS OF SPACE—where the money goes; THE WORLD AND SPACE—space progress in Europe; the military uses of space; THE SCIENCE OF SPACE—putting man on the Moon; the practical satellites; the explorations ahead; SPACE AND CHANGING IDEAS—the revolution in

education; the impact on theology; THE COLUMNISTS ON SPACE—views of columnists Crawford, Hazlitt, White (General Thomas D.), and Moley.

TWO TRIUMPHS IN SPACE FOR U. S. H-TESTS . . . . WORLD TV, in *U.S. News and World Report*, v. 53, no. 4 (23 July 1962) 35–38.

"First, a fantastic nuclear blast 200 miles high. Then, a new television satellite to astound the world." The stories of both show "U.S. moving ahead in arms and space with giant strides."

2. Budgetary Aspects.

THE BUDGET OF THE UNITED STATES GOVERNMENT 1964. Washington, Government Printing Office, 1963. 440 p.

The budget for the fiscal year ending June 30, 1964. Includes figures on National Aeronautics and Space Administration, as well as those of the Department of Defense.

THE COSTS OF SPACE EXPLORATION, by Addison M. Rothrock, in *Space-flight*, v. 4, no. 4 (July 1962) 106–114.

This paper was presented at a joint meeting of the British Interplanetary Society and the Royal Aeronautical Society, London, 13 Feb. 1962. The author is discussing certain aspects of the costs of the US Space Program concentrates on the work of NASA. Overall program costs, the space science program, factors affecting launch vehicle cost, tracking and data acquisition, et cetera. One appendix presents preliminary results from EXPLORER XII as of 19 Jan. 1962.

DOD SPACE POSITION DEFENDED, by Frank G. McGuire, in *Missiles and Rockets*, v. 12, no. 5 (4 Feb 1963) 12–14.

Defense Secretary Robert McNamara presented to Congress a Fiscal 1964 military budget calling for expenditure of over $10 billion on missiles and space. He stressed the increasing Air Force role with NASA. This article highlights the budget report. With chart showing by service the missile spending proposals in the new budget.

FY '64 BUDGET—PROGRAMS AT A GLANCE, in *Missiles and Rockets*, v. 12, no. 3 (21 Jan 1963) 14–15.

A list of programs and costs for those of Department of Defense, Atomic Energy Commission, NASA, and the Weather Bureau.

NEXT INSTALLMENT ON WAY TO THE MOON . . . . 5 BILLIONS, in *U. S. News and World Report*, v. 54, no. 2 (14 Jan 1963) 72–74.

"There's to be less 'glamour' in space this year, but it's still going to be expensive. U.S. dollars—and Russian rubles—are geared to the same big goal: men on the Moon."

RECORD $18.62 BILLION ASKED [FOR MISSILES AND SPACE], in *Missiles and Rockets*, v. 12, no. 3 (21 Jan 1963) 12–13 plus.

President Kennedy has asked Congress to approve a budget which provides $18.62 billion for missiles and space programs in Fiscal 1964 —almost one-fifth of the total budget request for the year. NASA's $5.7—billion request accounts for nearly all of the increase, while missiles level off and little allotted for military space. With charts showing: how missile/space spending has climbed; NASA R & D and operation in dollars for FY '62, '63, and '64; cost of NASA facilities constructions program by location; missile spending by services; and growth of military space spending.

3. Economic Impact.

ECONOMIC IMPACT OF THE SPACE PROGRAM, by George P. Miller, in *Signal*, v. 16, no. 12 (Aug 1962) 25 plus.

An address by the Hon. George P. Miller, Chairman, House Science and Astronautics Committee at the 1962 convention of the Armed Forces Communication and Electronics Association.

WHO GETS THE DEFENSE BILLIONS, in *U. S. News and World Report*, v. 53, no. 1 (2 July 1962) 68–70.

"It's an uneven boom, the one based on spending of defense and space billions. A glance at the map [included with report] shows why. A handful of States and localities are getting most of the business, most of the money. Prospect is that things will continue that way from now on. With a chart showing where the money is going in arms and space and the spending trends for the '60's."

WHO IS GETTING GOVERNMENTS RESEARCH BILLIONS, in *U. S. News and World Report*, v. 53, no. 8 (20 Aug 1962) 62–63.

"Where big defense orders will go in the future: to the companies and States with the best research facilities . . . Latest figures tell of a basic shift in the vast armaments industry." Presents the outlook for space spending and includes a chart: THE GROWING SPACE BUSINESS—AND WHERE IT IS HEADED (estimated spending of NASA, by State, on the basis of prime contracts).

4. National Security: Policy and Strategy.

ADMIRAL ARLEIGH (31-Knot) BURKE, by Ken Jones and Hubert Kelley, Jr. Philadelphia, Chilton Brooks, 1962. 203 p.

This biographical account of the life and military career of Admiral Burke includes information of the role played by him as Chief of Naval Operation in helping to shape US missile policies.

ATTAINING OUR GOALS IN SPACE, by Gen. B. A. Schriever, in *Signal*, v. 16, no. 9 (May 1962) 9 plus.

Gen. Schriever considers some of the factors that will contribute to the attainment of our national goals in space. "The potential of space . . . is greater than is generally realized. If we direct our efforts and resources wisely, we can attain our national objectives in space —and attain them in time."

BALLISTIC MISSILES AND MILITARY STRATEGY, in *Interavia*, v. 17, no. 11 (Nov 1962) 1434–1436.

"Ballistic missile strategy, or, in simpler terms, the possible employment of this weapon, depends on several technical factors, namely: the accuracy of the missile, the power of its warhead, and the nature of the target against which it is launched." Discusses the employment of ballistic missiles in: attack against missile bases, and strikes against populated areas.

CONFLICT IN SPACE; A PATTERN OF WAR IN A NEW DIMENSION, M. N. Golovine. London, Temple Press Limited, 1962. 146 p.

"The . . . . book is not a prophecy but a development of certain hypothesis," and the technical sections are founded almost entirely upon US thinking and practice. CONTENTS: EVOLUTION OF GRAND STRATEGY; TRANSITION FROM AIR TO AEROSPACE; GROWTH OF AEROSPACE TECHNOLOGY; INDUSTRY AND BUDGETS; FURTHER EVOLUTION OF AEROSPACE WEAPONS; AEROSPACE IN WORLD POLITICS AND STRATEGY; SCIENTIFIC AND CIVIL APPLICATIONS OF ASTRONAUTICS; ORBITALS AND PROBES LAUNCHED UP TO JULY 1, 1961; KILL PROBABILITIES OF BALLISTIC WEAPONS; and Bibliography.

DO WE MEAN BUSINESS IN SPACE? in *Fortune*, v. 66, no. 3 (Sept 1961) 91–92.

An editorial on the status of US space policies, in the face of Soviet accomplishments in space. Concludes by quoting Secretary of the Air Force Eugene Zuckert who wrote recently: "We must be able to enforce our stand on the peaceful uses of space."

DOD BALKS MOST MILITARY SPACE EXPANSION EXCEPT IN RECONNAISSANCE, in *Aviation Week and Space Technology*, v. 78, no. 10. (11 Mar 1963) 116–117 plus.

"Military space activity reducing the intelligence imbalance between U.S. and Soviet Russia continues at a rapid pace, but other military space programs remain stymied because they have failed to receive top-level Defense Department and Air Force support. Two basic parts comprise the U. S. defense effort: a broadly based intelligence—gathering program which is successfully exploiting the most advanced concepts in sensors and space flight technology, and the segment including communication and navigation satellites which is openly reflected in the budget."

THE GAPS IN OUR AEROSPACE DEFENSE, by Gen. Laurence S. Kuter, in *Air Force*, v. 45, no. 8 (Aug. 1962) 47–48 plus.

In a valedictory statement, the man who directed the North American air defenses summarizes our accomplishments, but points out serious flaws in our defense against missiles and the potential threat of armed satellites.

HOW OUR SPACE POLICY EVOLVED, by Claude Witze, in *Air Force*, v. 45, no. 4 (April 1962) 83–84 plus.

"Emotionally based attitudes, 'pound-foolish' economy, over-conservatism . . . . , and political pressures, domestic and foreign, have combined to hold back the need of straightforward search for strong US military capabilities in space . . . . " Deep acceptance of the military significance of space is still far from universal, while "Soviet space prowess increases."

THE MISSILE SUBMARINE: TOTAL OR PARTIAL DETERRENT? by M. P. Gallois, in *Interavia*, v. 17, no. 5 (May 1962) 570–572.

To detect and destroy simultaneously all the POLARIS-carrying submarines which will figure in the US Navy's inventory seems today an almost impossible task. However, notwithstanding the advantages which the submarine appears to have over the defense, it is not without its drawbacks. The great advantage of the undersea ballistic weapon is the secrecy in which it can shroud its movements. "Although no more than mediocre as a weapon of aggression," the submarine launch platform has advantages in the deterrence of a potential aggressor. Although the missile-launching submarine has "burst" into world strategy and no method of defense against it is yet known, considerable intellectual and material resources will from now on be devoted in solving the problems. "In any event, the more deterrent submarines there are, the longer this arm will retain its remarkable authority."

NEEDED: A SPACE-AGE PLATFORM FOR US STRENGTH, by Howard W. Cannon, in *Air Force*, v. 45, no. 10 (Oct 1962) 51–53.

Senator Cannon of the Senate Space and Armed Services Committees "warns that our present program provides little assurance of US development of military space capabilities." He urges that we extend the deterrent formula into aerospace—and lists important priorities.

1963: THE GREATEST YEAR IN SPACE, by James E. Webb, in *Aerospace*, v. 1, no. 1 (Mar 1963) 2–7.

A brief introductory resume of the US "stepped-up effort toward that national goal of pre-eminence in space," and ten important milestones "which we hope to pass during 1963, or early 1964," in the fields of: unmanned investigations in space, advanced research and technology, and space applications.

OUR SPACE EFFORTS: HOW MUCH ARE THEY REALLY WORTH TO US? by William H. Meckling, in *Air Force*, v. 45, no. 7 (July 1962) 58–60.

"Economists are always . . . . asking about costs and returns, ... if we are to be hardheadedly realistic about the impact of space technology, particularly on the international level, we must ask ourselves such questions and not go on faith as we chart the large expenditures of money and effort to come . . . . "

THE PENTAGON PONDERS STRATEGY, in *Interavia*, v. 17, no. 10 (Oct 1962) 1296–1298.

"It is inevitable that any review of the US military space effort written at this moment is overshadowed by the 'recent' Russian VOSTOK 3 and VOSTOK 4 exploits. But, to obtain a better perspective of the situation, it is necessary to go back and examine the background history of the purely military programme." The brief historical review illustrates the changes and shifts in policy which have occurred as experience has been gained in space technology, and with the increasing realization of the importance of its military applications. The article summarizes the US military space program as of mid-1961 and discusses orbiting missiles and the strategic arguments in favor of orbital offensive weapons. The results of studies of such weapons probably has served to convince the Dept. of Defense of their feasibility and the possibility that the Soviets, whose interest in such weapons was already known, might be developing them. "There is yet no sign that the major [US] decision has been taken as to whether to concentrate on an offensive or defensive system . . . . It remains to be seen whether the efforts devoted to a large number of feasibility studies will ultimately balance the apparently more single-minded approach of the Russians."

THE RACE FOR SPACE, by Robert C. Seamans, Jr., in *Ordnance*, v. 47, no. 254 (Sept–Oct 1962) 178–181.

The US is pushing forward on a broad front to be the first in space in order to pursue our quest for scientific knowledge; to realize the benefits of satellites in the fields of meteorology,

communications, and navigation; to preserve our international position; and to protect our military potential. The author, Associate Administrator of NASA, tells of our progress in these areas and of our plans to put explorers on the Moon in this decade.

REPORT TO THE CONGRESS FROM THE PRESIDENT OF THE UNITED STATES. UNITED STATES AERONAUTICS AND SPACE ACTIVITIES 1962. Washington, Executive Office of The President, 1963. 139 p.

The report covers the nation's aeronautics and space activities for the calendar year 1962. In his letter of transmittal The President point-out that: " . . . . The Year 1962 was a period of acceleration, accomplishment, and relative progress for the United States in its space leadership drive. In both numbers and complexity of space projects, the past year was the most successful in our brief but active space history." The table of contents of the report are: Chapter I—U. S. AERONAUTICS AND SPACE ACTIVITIES — 1962 — SUMMARY; Chapter II — NATIONAL AERONAUTICS AND SPACE COUNCIL; Chapter III—NATIONAL AERONAUTICS AND SPACE ADMINISTRATION; Chapter IV — DEPARTMENT OF DEFENSE; Chapter V—ATOMIC ENERGY COMMISSION; Chapter VI—DEPARTMENT OF STATE; Chapter VII—NATIONAL SCIENCE FOUNDATION; Chapter VIII — DEPARTMENT OF COMMERCE; Chapter IX — SPACE SCIENCE BOARD; Chapter X—SMITHSONIAN ASTROPHYSICAL OBSERVATORY; Chapter XI—FEDERAL AVIATION AGENCY; Chapter XII—FEDERAL COMMUNICATIONS COMMISSION; Chapter XIII—UNITED STATES INFORMATION AGENCY. Appended: U.S. LAUNCHING RECORD 1957–1962; SUCCESSFUL U.S. LAUNCHES—1962; U.S. SPACE LAUNCH VEHICLES; HISTORICAL BACKGROUND AND COMMUNICATIONS SATELLITE ACT OF 1962; HISTORICAL SUMMARY AND FY 1964 BUDGET RECOMMENDATIONS; and SPACE ACTIVITIES BUDGET.

RUBEL SPELLS OUT SPACE PHILOSOPHY, in *Missiles and Rockets*, v. 11, no. 17 (22 Oct 1962) 37–38.

Condensed version of speech delivered by Asst. Secretary of Defense John H. Rubel bemore the Aerospace Luncheon Club in Wash., D. C., in which he presented DOD's attitude toward the military in space. He also noted that the space R & D effort is likely to top $1.5 billion in 1963 and that hardware funds have been tripled.

Rx FOR SPACEBORNE DETERRENCE, by J. S. Butz, Jr. in *Air Force*, v. 45, no. 4 (April 1962) 48–49 plus.

For viable American spacepower, man's unique abilities seem essential. In addition, we must have more nuclear data, lower the high costs of launching, attain a high degree of maneuverability in space, and work toward much-increased reliability. This analysis reviews critical areas in which immediate decision and rapid action are required.

SEC. MCNAMARA OUTLINES DEFENSE DEPT. PLANS FOR SPACE, in *Missiles and Rockets*, v. 11, no. 17 (22 Oct 1962) 14–15.

An interview with the Secretary of Defense in which he "states for the first time some of his views on the role of the military in space—and how the role may develop in the future. The interview . . . . indicates that the official Pentagon attitude toward military space activity has become, for the time being at least, more favorable than might have been gathered from previous, fragmentary DOD pronouncements. In general, the Secretary states that while he sees no 'clear' military space requirement now, DOD is keeping an open mind."

STORY OF CHANGE IN U. S. DEFENSES, in *U. S. News and World Report*, v. 53, no. 27 (31 Dec 1962) 29–31.

"Another 'new look' is altering the U. S. arsenal. Reliable, longe-range missiles are coming on in a rush. That means less emphasis on big bombers, and rounding out of conventional arms so U.S. will be ready for war on any terms."

THINKING ABOUT THE UNTHINKABLE, by Herman Kahn. New York, Horizon Press, 1962. 254 p.

Missiles and their employment figure prominently in this book since the author

delves into the possible sizes and shapes of thermo-nuclear war and the various strategic concepts and types of deterrence and the politico-military implications arising in various types of scenarios which he proposes and analyses (e. g. Chapter Five: SCENARIO II: A MISSILE GAP RESULTS IN A CALCULATED AND CONTROLLED WAR).

THE ULTIMATE WEAPON IS FORESIGHT, by Gen. Curtis E. LeMay, in *Air Force*, v. 45, no. 5 (May 1962) 26 plus.

"While we wait for distinct signs that we are in fact making progress toward disarmament, we must continue to make adequate preperations for free man's defense. To present a fatal technological surprise in the 1970's, those preparations must include military capabilities in space."

U.S. BASES ABROAD, in *Time*, v. 80, no. 19 (9 Nov 1962) 17.

A one-page summary of the US overseas base strategy and structure. Points out that "In US strategic planning, the importance of strategic bases overseas has waned in the last couple of years, and will continue to diminish the the years ahead. POLARIS missile submarines have given the US a mighty strategic wallop that is independent of fixed bases overseas. The US's growing force of operational ICBMs—ATLAS, TITAN, and before long, MINUTEMAN—is being stationed entirely within the US. But as long as Communism seeks world domination, the US will continue to need military installations abroad." The article evaluates the status and provides weapons data on bases in: Britain, Italy, Turkey, France, West Germany, The Netherlands, Iceland, Greenland, Spain, Portugal, Morocco, Libya, Japan, Okinawa, South Korea, Formosa, The Philippines, Guam, Canada, Bermuda, Puerto Rica, Canal Zone, Trinidad, and Cuba.

U.S. POWER IN THE SPACE COLD WAR, by William Leavitt, in *Air Force*, v. 45, no. 4 (Apr 1962) 39–40 plus.

"The development of military space capabilities in an uncertain world deserves priority equal to the urgency attached to the massive moon program. We must, at all costs, prevent technological surprise from space that could upset the power balance."

B. Missiles/Space Projects and Programs.

1. Miscellaneous Information.

AMERCA'S SPACE PROGRESS, by Col. Carlo R. Tosti, in *Ordnance*, v. 46, no. 252 (May–June 1962) 770–773.

The year 1961 was one of substantial progress in space programs in the Nation. The author tells of the notable gains in the X–15, DISCOVERER, MIDAS, MERCURY, and TIROS programs, and indicates "further remarkable achievements in the future."

AMERICA'S SPACE VEHICLES: A PICTORIAL REVIEW, by Will Eisner. New York, Sterling, 1962. 140 p.

A complete and brief summary of America's space vehicles. The framework upon which this book is built is the ten-year (1959–1969) projection of goals which NASA has set for itself. Calendar of space probes October 4, 1957 (SPUTNIK I) to October 21, 1961 (MIDAS IV): timetable for US space explorations (presented in pictorial form) 1960–1969; the Soviet space program 1957–1961; launch vehicles [JUNO II, SCOUT, THOR DELTA, THOR, AGENA B, ATLAS (MERCURY), ATLAS ABLE, ATLAS AGENA B, ATLAS CENTAUR , SATURN (C–1), SATURN (C–3), NOVA]; Rocket motors, sounding rockets; earth satellites; lunar vehicles (unmanned); interplanetary vehicles (unmanned); manned space vehicles; interplanetary vehicles (manned); power generating systems; and space communications. Glossary.

GALLERY OF AMERICAN MISSILES AND SPACE WEAPONS, in *Air Force*, v. 45, no. 4 (April 1962) 121–122 plus.

A full compendium of all available unclassified data on the US missile arsenal, including weaponry of all three military services, Army, Navy, and Air Force.

GALLERY OF USAF WEAPONS—MISSILES, in *Air Force*, v. 45, no. 9 (Sept 1962) 226–228.

Available unclassified data and photos of the following: SM–65 ATLAS, SM–68 TITAN, SM–75 THOR, SM–78 JUPITER, SM–80 MINUTEMAN, IM–99 BOMARC, TM–76 MACE, MB–1 GENIE, GAR–1, –2, –3, –4, –11

FALCON, GAR–8 SIDEWINDER, GAM–72 QUAIL, GAM–77 HOUND DOG, GAM–83A BULLPUP, GAM–87A SKYBOLT.

A LOOK AT AMERICA'S MISSILE ARSENAL, in *U.S. News and World Report*, v. 54, no. 11 (18 Mar 1963) 66–68.

A review of our missile arsenal showing by photos accompanied by brief descriptions and other data such as deployment, quantities, et cetera: big missiles able to hit Russia's homeland, missiles for defense against enemy aircraft, battlefield missiles for use against enemy troops, missiles fired by planes at enemy planes, missiles to hit other missiles, antisubmarine missiles, and bomber-borne missiles.

MISSILES AND SPACE SYSTEMS—1962, by H. H. Koelle, in *Astronautics*, v. 7, no. 11 (Nov 1962) 29–37.

The progress of missiles and space systems in the past 14 months. "With vast missile programs leveling out, and our immediate space objectives well in hand, we must look to the future—to plans for extensive lunar and interplanetary travel—to evaluate the space program's 'state-of-the-art vs. time curve.'" With a condensed log of the progress of the last 14 months.

TITANS ON FIRING LINE: NEW MUSCLE FOR U. S., in *U.S. News and World Report*, v. 52, no. 18 (30 Apr 1962) 68–70.

"For U.S., this is 'the year of the big payoff' in missiles. You see why in this look at a mighty array of long-range weapons that are now in place—ready to fire. And more will be ready soon."

U.S. SPACE EFFORT TURNS TO GEMINI, APOLLO, by Edward H. Kolcum, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 March 1963) 107–109 plus.

"Vast U.S. investment in manned space flight during the next 12 months will be a down payment on the future and will not buy large numbers of flights this year. Maj. Gordon Cooper's attempt to wring the maximum performance from the MERCURY capsule in late spring is the only manned flight scheduled this year. If successful, the MA–9 will conclude the MERCURY program and set the stage for GEMINI in 1964 and APOLLO a year later."

2. Anti-Missile Defense.

ANTI-MISSILE DEFENSE TAKES SHAPE, by James Holahan, in *Space/Aeronautics*, v. 39, no. 4 (Apr 1963) 76–80.

"The Russians' Cuban adventure brought home to America at large how vulnerable we were to a missile hit." How NIKE-X, SPRINT, ZEUS, HAWK, MAULER, and TYPHON will be some of our counterpunches. (Note: for more information on missiles in Cuba see Special Appendix.)

ANTIMISSILE MEASUREMENT, by Capt. Henry F. Magill, in *Ordnance*, v. 47, no. 255 (Nov–Dec 1962) 370–372.

Soon after the development of practical ballistic missiles it was realized that we had no defense against this weapon. As an initial effort in finding some means of combating this threat, the Downrange Antimissile Measurement Program (DAMP) was established to see what an oncoming missile "looked like." Capt. Magill explains how spectral radiant intensity and other nose-cone phenomena are measured by such observation ships as the American MARINER.

DOD SAYS AICBM IS FEASIBLE, by James Trainor, in *Missiles and Rockets*, v. 11, no. 26 (24 Dec 1962) 14–15.

"ICBM defense is feasible—and worthwhile under certain conditions." Project DEFENDER research and systems studies—combined with the NIKE-ZEUS tests in the Pacific—have enabled DOD planners to clarify the ballistic missile defense problem to the extent that a new operational concept is evolving. Basically, this concept involves two ballistic missile defensive systems—a Hard Point Defense (HPD) system for the protection of ICBM bases and command and control posts and an Urban Defense System. NIKE-ZEUS is an example of the latter. A more effective AICBM system, presumably based on this operational concept, is now under both conceptual and hardware development.

HARD POINT ICBM DEFENSE EFFORT PUSHED, by Philip J. Klass, in *Aviation Week and Space Technology*, v. 78, no. 1 (7 Jan 1963) 34.

Program to investigate the technical feasibility of a relatively simple, low-cost ICBM defense system, specifically designed to protect hardened underground missile sites and vital command centers is getting increased emphasis. The hard point defense concept envisions an anti-ICBM missile system which—unlike NIKE-ZEUS—is readily adaptable to hardening, including its detection radars. The interceptor missiles would have extremely high acceleration and maneuverability, but only relatively short range. Intercept might occur at altitudes of 10–20 mi., perhaps even lower.

LIGHT—SPACE AGE TOOL, by Walter A. Murphy, in *Ordnance*, v. 46, no. 252 (May–June 1962) 825–828.

This silent, swift energy activates the electric eye of automatic control devices, provides a long-term source of power for space vehicles, and "flashes the hope of more effective guidance and communication." The author also tells how the recently developed optical masers might possibly be used to generate a 'death ray' to destroy hostile missiles."

AN UNSOLICITED PROPOSAL: PROJECT TURNABOUT AICBM SYSTEM, in *Air Force*, v. 46, no. 2 (Feb 1963) 44–46.

"The difficulties to be overcome in providing an effective and reliable AICBM system are well known. These difficulties have led to several proposed systems that border on the impractical, either because of excessive cost, excessive research and development time, undesirable side effects, or (often) all three together. The objective of this proposal is to describe a promising AICBM technique that is much more practical. There are a few minor difficulties, but these should be surmountable with a relatively modest R & D effort."

3. Surveillance and Detection.

MARS SHIPS MAY AID DECOY, A-ICBM PROGRAMS, by Michael Betler, in *Missiles and Rockets*, v. 10, no. 23 (4 June 1962) 34–35.

How the stationing of two Mobile Atlantic Range Station (MARS) tracking ships downrange from Cape Canaveral may provide US defense planners with vital information on detection and sorting of real ICBM's from missile decoys. A discussion of the ten-ship plan and the assignments of the ships' instrumentation.

SPADATS NETWORK RELIES ON VARIED SENSORS, by Philip J. Klass, in *Aviation Week and Space Technology*, v. 78, no. 7 (18 Feb 1963) 89 plus.

In the five years since SPUTNIK I "initiated the space age," the North American Air Defense Command (NORAD) has assembled an effective space surveillance network using a variety of sensors, many of which were never designed for such purpose. The network is knowns as SPADATS (Space Detection and Tracking System). For example, the Air Defense Command's Ballistic Missile Early Warning System (BMEWS) radars in Greenland and Alaska, in addition to their intended role, are primary sources of data on Soviet and US satellites. Also discusses aside from SPADATS sensors, other military sensors, non-military sensors, the 71st Surveillance Wing, 2nd Surveillance Squadron, 1st Aerospace Surveillance and Control Squadron, et cetera.

SPASUR NET GIVING VITAL NORAD COVERAGE, by Philip J. Klass, in *Aviation Week and Space Technology*, v. 77, no. 22 (26 Nov 1962) 52–53 plus.

The Naval Space Surveillance System (NAVSPASUR) has developed from a "jerry-built experiment into a vital operational element" in the North American Air Defense Command's Space Detection and Tracking System (SPADATS) in less than four years. The author discusses: the data obtainable from a single and second pass of an object through the SPASUR fence; the network location; the six-station network which was in operation by Feb. 1959; the receiving stations; and administrative and engineering features and improvements which have occurred up to the present time.

SPY SATELLITES HIT TECHNICAL SNAGS, by William Beller, in *Missiles and Rockets*, v. 11, no. 17 (22 Oct 1962) 22–23.

Satellites for ballistic-missile early warning and surveillance of space targets are running into technical questions similar to those encountered in the Navy's antisubmarine-warfare problem—and equally intransigent. The difficulty in space is to devlop systems sensitive and versatile enough to single out potential

targets from the background "noise" of Earth, atmosphere and sky. To help solve this problem, Northrop has begun a program to simulate the celestial environment. A further complication in space is the need to find targets within a relatively short time span; on the other hand, there is no barrier such as water to prevent "seeing."

4. ADVENT.

THE ADVENT SATELLITE COMMUNICATIONS SHIP, by Lt. Comdr. B. I. Edelson and Lt. Comdr. S. N. Ross, in *Signal*, v. 16, no. 11 (July 1962) 4–6 plus.

Overall systems management of ADVENT has been the responsibility of the Department of the Army since Sept. 1962. The Air Force has since 1960, had the responsibility for launching operations for ADVENT, with the US Army Signal Research and Development Laboratory, Fort Monmouth, N. J., providing technical support. This reoriented program will include the research and development necessary to demonstrate the feasibility of a microwave communications satellite operating in a 24-hour equatorial synchronous orbit. The satellite will be operated in two ground stations, one on each coast. A shipboard station, to be provided by the US Navy is described in this article, showing ship arrangement, shipboard antenna subsystem, and shipboard communications and tracking, telemetry, and command subsystems.

ARMY'S ADVENT CANCELLED . . . DOD CHANGES COMSAT PLANS, by James Trainor, in *Missiles and Rockets*, v. 10, no. 25 (18 June 1962) 12–13.

The Air Force received the major responsibility as bids were prepared for two new communications satellite systems, due to be operational by 1966.

PROJECT ADVENT, MISSION AND MANAGEMENT, by John P. Kushnerick, in *Aerospace Management*, v. 5, no. 5 (May 1961) 18–22.

"No way exists to repair unmanned spacecraft in orbit. Long-life must be built in. ADVENT, aims to prove the feasibility of a worldwide communications net using long-life satellites. Army has the overall program responsibility. Exercises 'micromanagement' through a special ADVENT Management Agency at Fort Monmouth."

5. ANNA.

ANNA'S FUTURE REMAINS IN DOUBT, by James Trainor, in *Missiles and Rockets*, v. 11, no. 19 (5 Nov 1962) 15.

Successful launch of the ANNA geodetic satellite in late 1962 may revive lagging Government interest in the program. But both Navy and NASA are reluctant to commit themselves to a continuing program until after final test results are evaluated.

6. APOLLO.

AN AMERICAN ON THE MOON—A $20 BILLION BOONDOGGLE? in *U.S. News and World Report*, v. 53, no. 8 (20 Aug 1962) 52–61.

The US plan now is to send three men out to the Moon and back just five years from now, and the goal—to get there before Russia does. The question arises why we should plan for this? "Is there something on the Moon worth $20 billion dollars? Is this scientific? Military? Or is it turning into a fantastic waste of resources?" These are some of the questions being raised about America's Project APOLLO. To get expert views, staff members of U.S. News and World Report talked with leading space authorities here and abroad. Their answers "bring the Moon race into new, sharper focus." Interviews include: Aim—To Learn How World Began (interview with Dr. John A. O'Keefe, scientist, NASA); A Lunar Landing by 1970 (interview with John W. Paup, APOLLO Program Manager, North American Aviation); Man is a Nuisance in Space (interview with Dr. R. L. F. Boyd, physicist, University College, London); We're Proceeding Too Rapidly (interview with Senator William Proxmire, Wisconsin); and Defense Gains in Space (interview with Lt. Gen. James Ferguson, USAF, Deputy Chief of Staff for Research and Technology).

AMERICA'S RACE FOR THE MOON; THE NEW YORK TIMES STORY OF PROJECT APOLLO, ed. by Walter Sullivan. New York, Random House, 1962. 163 p.

This book is based on a series of articles on the APOLLO program which appeared in

The New York Times. Partial contents: PROLOGUE—TO THE MOON—A CENTURY AGO, by Walter Sullivan; WE ARE GOING, by Richard Witkin; WHO IS DOING THE JOB? by Richard Witkin; HOW TO GET THERE, by Harold M. Schmeck, Jr.; PROJECT GEMINI—LEARNING TO LIVE IN SPACE, by Harold M. Schmeck, Jr.; SPACEPORT U.S.A., by Walter Sullivan; TRACKING AND COMMUNICATIONS, by Walter Sullivan; MOON PIONEERS—SELECTION AND TRAINING, by Richard Witkin; WHAT WILL THE MOON BE LIKE, by Walter Sullivan; TASKS FOR THE FIRST EXPLORERS, by Walter Sullivan; SPACE INFECTION, by Harold M. Schmeck, Jr.; SOVIET ENIGMA, by David Binder. Appendix: Space Glossary, and Moon Facts.

APOLLO RESHAPES NASA, INDUSTRY ROLES, by Evert Clark, in *Space Technology International*, v. 5, no. 3 (July 1962) 6–10.

How the vast undertaking of landing US astronauts on the Moon by 1970 is producing new management patterns and problems in NASA.

APOLLO'S COMMUNICATIONS AND DATA SYSTEM, by Roger J. Pierce, in *Missiles and Space*, v. 11, no. 2 (Feb 1963) 26–27 plus.

Basic configuration of space-borne support equipment for Moon mission.

DOLLARWISE, HOW HIGH THE MOON? by J. S. Butz, Jr., in *Air Force*, v. 46, no. 3 (Mar 1963) 56.

$20 to 40 billion "have been the ball-park" figures for the cost of NASA's Project APOLLO Moon-landing expedition. An examination of the level of NASA spending indicates that the final price tag will be much closer to the larger figure.

MAN'S ROLE IN APOLLO, by Robert R. Gilruth and L. M. McMillion, in *Aerospace Engineering*, v. 21, no. 9 (Sept 1962) 42–48.

The APOLLO space vehicle will take a crew of three to the Moon and return them to Earth. The on-board command and decision-making capability will enhance mission reliability and safety. The flight crew will have on board all the resources necessary for mission completion. The APOLLO spacecraft is being designed to utilize the capabilities of the crew and various automatic systems. The discussion of selected mission phases illustrates the close interaction between the crew and spacecraft systems. Man's role in APOLLO is, therefore, the efficient use of his own talents and those of the systems at his disposal.

NASA PICKS LUNAR-ORBIT ROUTE, by Hal Taylor, in *Missiles and Rockets*, v. 11, no. 2 (9 July 1962) 12–13.

NASA has concluded its systems engineering review of Project APOLLO with a decision in favor of lunar-orbit rendezvous for the first manned lunar-landing mission. The immediate ramifications of the US space program is outlined. Also the author discusses briefly how the APOLLO mission will be accomplished.

[A SPECIAL REPORT ON PROJECT APOLLO] in *Missiles and Rockets*, v. 10, no. 21 (21 May 1962) 16–21 plus.

Almost the entire issue is devoted to this special report on APOLLO, detailing where the project now stands, the problems encountered, technical progress, et cetera. Includes: $6 BILLION TO BE SPENT DURING NEXT TWO YEARS; TECHNOLOGY IS EQUAL TO COMPLEX PROBLEMS (Guidance and Control, Tracking/Data Acquisition, Re-entry, Telecommunications, Spacecraft, and Space Medicine); NASA HEADQUARTERS BUILDS VAST MANAGEMENT COMPLEX; EMBRYONIC HOUSTON CENTER OVERSEES SPACECRAFT WORK; MARSHALL LAYS PLANS, AWAITS RESULTS OF REVIEW; MIT, FOUR FIRMS INVOLVED IN GUIDANCE SYSTEMS; TEST STANDS, PADS PLANNED AT MISSISSIPPI CAPE; NORTH AMERICAN IS BIGGEST INDUSTRIAL CONTRACTOR; CHRYSLER PREPARES TO PRODUCE S–1 BOOSTERS; BOEING TO TURN OUT 25 ADVANCED SATURN 1ST STAGES; DOUGLAS BUSILY FABRICATING SATURN S–IV STAGES; OTHER CONTRACTORS—FIVE SHARE $600 MILLION.

SYSTEMS CHECKOUT FOR APOLLO, by J. E. Sloan and J. F. Underwood, in *Astronautics and Aerospace Engineering*, v. 1, no. 2 (Mar 1963) 37–40.

How NASA has instituted an across-the-board study of automatic checkout to meet the demand for unparalleled reliability in the manned lunar landing program.

7. ARCAS.

IMPROVED ARCAS AIDS ANTARCTIC RESEARCHERS, by Tom Kilpatrick, in *Missiles and Rockets*, v. 11, no. 23 (3 Dec. 1962) 24–25.

Recent modification of the ARCAS sounding rocket has significantly increased chances of overall success in the first Antarctic-based, upper-atmosphere research rocket program. The National Science Foundation which sponsors US Antarctic research, has announced that modified ARCAS rockets recently shipped to the South Pole are performing consistently well in the Antarctic spring series of research rocket shots. The program is funded by the Foundation and conducted by Schellinger Research Laboratories of Texas Western College. The success to date of the current series is in sharp contrast to reports of only partially successful efforts during the winter season when very low temperatures and high winds plagued launch operations. The author includes information on: network hardware, motor for ARCAS, launching system, problems encountered, et cetera.

8. ASSET.

FIRST ASSET LAUNCHES DUE IN SUMMER, by Frank G. McGuire, in *Missiles and Rockets*, v. 12, no. 2 (14 Jan. 1963) 18.

Launch of six vehicles in the Air Force's ASSET program is scheduled to begin this summer from Cape Canaveral, with different trajectories for each of the suborbital flights. The program is intended to gather re-entry data for various materials and check out design theories. ASSET (Aerothermodynamic/Elastic Structural Systems Environmental Tests) use two types of vehicles resembling X–20 (DYNA-SOAR). The craft will be launched by THOR and THOR-DELTA boosters.

9. ATLAS.

ATLAS ACCURACY IMPROVES AS TEST PROGRAM IS COMPLETED, by George Alexander, in *Aviation Week and Space Technology*, v. 78, no. 8 (25 Feb 1963) 54–55 plus.

"Air Force confidence that it can, in the event of war, deliver nuclear warheads to within 2 naut. mi. of targets in the Soviet Union and Communist China with 80% of its 126 ATLAS intercontinental ballistic missiles is based on the weapon system's five-year flight test record . . . ." The author discusses the ATLASES': thin-skin construction; contaminant control in liquid oxygen systems; staging; liquid oxygen handling; booster tests; heating problem; ATLAS–A results; guidance system; impact accuracies; test of ATLAS 13–B; et cetera. Also a listing of ATLAS' role in space missions.

10. BOMARC.

THE BOMARC WEAPON SYSTEM, by Lt. Col. Charles E. Minihan, in *Air University Quarterly Review*, v. 13, no. 4 (Summer 1962) 56–73.

In 1962 the Air Defense Command "reached a significant aerospace milestone: with the complete tactical deployment, in support of the North American Air Defense Command, of the IM–99 weapon system BOMARC." The surface-to-air BOMARC is a classic example of the guided missile, "though it is more accurately described as a pilotless interceptor aircraft." Research and development leading to the supersonic, high-altitude, target-killer BOMARC was begun in 1950, and 12 Jan. 1951, the US Air Force authorized the development of the BOMARC weapon system.

11. DAVY CROCKETT.

DAVY CROCKETT REPORTED SUCCESSFUL, by James Trainor, in *Missiles and Rockets*, v. 11, no. 4 (23 July 1962) 36.

In a test with troops, Davy Crockett, one of the Army's most mobile tactical atomic delivery systems, was carried out under simulated battlefield conditions at the AEC Nevada Test Site on 17 July. The author describes briefly the system and its deployment.

12. DELTA.

RELIABLE DELTA TO GET MORE WORK, by Chris Butler, in *Missiles and Rockets*, v. 11, no. 13 (24 Sept 1962) 28–29.

Two new versions of the DELTA launch vehicle are expected to assume heavy workloads throughout the remainder of this decade at NASA adds additional missions to the booster's roster. Total missions already completed to date or new assigned to DELTA stand at 33. Last vehicle of the original DELTA group was used in September's launch of TIROS IV. The early type will be succeeded by intermediate DSV–3A and advanced DSV–3D models.

13. DYNA-SOAR and X–20.

DYNA-SOAR—THE SPACE GLIDER, by Robert L. Twiss, in *Ordnance*, v. 46, no. 251 (Mar–Apr 1962) 711–712.

Now in the early development stages, DYNA-SOAR is a winged vehicle, that will be shot into earth orbit by a booster rocket and then glide back to a controlled landing. According to the author the project may be to space flight what the Wright brothers' first airplane was to heavier-than-air travel.

MANNED SPACE FLIGHT, by Vern Haugland, in *Ordnance*, v. 47, no. 256 (Jan–Feb 1963) 430–434.

Up to the present time our man-carrying satellites have been governed mainly by the laws of ballistics, but the X–20 DYNA–SOAR delta-winged glider will be able to maneuver during return from orbit and travel through the atmosphere in controlled flight to a safe landing on earth. The author states that the 3-stage TITAN III launch vehicle will be able to place 13,000 pounds in orbit.

TECHNICAL DETAILS OF X–20 REVEALED, by Russell Hawkes, in *Missiles and Rockets*, v. 11, no. 14 (1 Oct 1962) 31–32.

Further technical details of the DYNA-SOAR space vehicle which were disclosed at the Air Force Association convention in Las Vegas. Also unveiled were probable command and control methods by which the Air Force plans to bring the X–20 and other manned space vehicles back to Earth.

USAF, NASA PLANNING HYPERSONIC RESEARCH AIRCRAFT, by Edward H. Kolcum, in *Aviation Week and Space Technology*, v. 78, no. 6 (11 Feb 1963) 26–27.

Air Force and NASA have begun two-year analytical studies to determine what concepts and requirements will dictate design of the manned hypersonic aerospace research vehicle that will follow the X–20 A (DYNA-SOAR). The goal is to arrive at a national policy position by 1965 on whether the next generation aerospace research vehicle should be an air-breathing cruise vehicle, a single-stage-to-orbit Aerospace Plane, a combination of the two, or an entirely new concept.

14. GEMINI.

GEMINI, by Octave Romaine, in *Space/Aeronautics*, v. 38, no. 5 (Oct 1962) 54-59.

Next to APOLLO, GEMINI is NASA's most important project. This article offers a review of this program for two-week orbital flights (beginning in 1964) and the first space rendezvous to be performed by US astronauts. It analyzes the GEMINI flight plan from launch through injection, orbital transfer, rendezvous, and re-entry, and it gives a description of the vehicle's basic configuration and its environmental, guidance, and control systems.

GEMINI, in *Western Aerospace*, v. 42, no. 9 (Sept 1962) 14–16.

"Our move in the man-in-space game, ... How do we stand? Where do we go from here . . . . ?"

GEMINI BOOSTER ASSEMBLY LINE READIED, by John F. Judge, in *Missiles and Rockets*, v. 11, no. 10 (3 Sept 1962) 32–33.

The first of 15 man-rated GEMINI Launch Vehicles "will roll out of the Martin Co.'s Baltimore Plant sometime in January 1963." The huge vehicles are essentially TITAN II boosters with extensive system redundancy and malfunction detection devices. The basic manufacturing program for the GEMINI boosters is integrated with the TITAN II production schedule.

GEMINI TO BE USED AS SPACE MEDICAL LAB, by Erwin J. Bulban, in *Aviation Week and Space Technology*, v. 78, no. 8 (25 Feb 1963) 79–80.

How two-man GEMINI spacecraft will provide a space laboratory facility of significant value for aerospace medical research compared with the short-duration one-man MERCURY system.

TRAINER TO SIMULATE GEMINI MISSION, by William Beller, in *Missiles and Rockets*, v. 12, no. 13 (1 Apr 1963) 24–25.

How a special digital computer has been designed and built and wired to modified capsule for crew instruction.

WHAT'S IN STORE FOR OUR GEMINI ASTRONAUTS, by J. S. Butz, Jr. in *Air Force*, v. 45, no. 8 (Aug 1962) 35–39.

The GEMINI capsule, boosted by SATURN and the TITAN II, should move the US man-in-space program out of the flyweight class within two years. GEMINI will maneuver at orbital speeds, exploring the feasibility of space rendezvous. How this will be done is reviewed by the author. He touches on launch, rendezvous the space station, re-entry, and landing.

15. HELIOS.

HELIOS TO RELAY MORE ACCURATE SOLAR DATA, by Warren C. Wetmore, in *Aviation Week and Space Technology*, v. 78, no. 9 (4 Mar 1963) 48–49 plus.

Second-generation Orbiting Solar Observatory (OSO)—known as the Advanced Orbiting Solar Observatory, or HELIOS—will be designed to have a pointing accuracy of 5 sec. of arc and 70% over-all system reliability.

16. HI-HOE.

PROJECT HI-HOE SCORES FIRST SUCCESS, by Richard van Osten, in *Missiles and Rockets*, v. 11, no 8 (20 Aug 1962) 16–17.

An inexpensive system for air-launching high altitude research probes and small orbital payloads is under test and development at the Naval Ordnance Station at China Lake, Calif. The first successful air launch of a two-stage CALEB rocket carrying a scientific payload to an altitude of 630n. mi. took place July 25. This launch was part of Project HI-HOE which is geared toward research; it may for the future have some long-range applications.

17. IMP (Interplanetary Monitoring Probe).

IMP SOLAR FLARE DATA MAY SAVE LIVES OF ASTRONAUTS, by William Beller, in *Missiles and Rockets*, v. 10, no. 17 (23 Apr 1962) 32–33.

Satellites developed by NASA's Goddard group will also investigate Earth-Sun relationships. The lives of some future APOLLO astronauts may depend on how successfully a newly disclosed monitoring satellite called IMP (Interplanetary Monitoring Probe) gathers data from cislunar space. On the lookout for proton and other solar radiations, an IMP is intended to be in orbit at all times—starting from the scheduled first launch in the second quarter of 1963. A prime purpose of IMP is to help develop a way to anticipate solar flares.

18. KIWI.

ATOMIC POWER FOR SPACE, by Otto Renius, in *Ordnance*, v. 47, no. 253 (July–Aug 1962) 39–42.

Although chemical boosters will be needed to propel spacecraft through the dense atmospheres of Earth, once in the realm of space the nuclear rocket is superior for interplanetary travel and for missions which require a large payload. Discusses how experiments with the KIWI nuclear engine are developing a means of propulsion that someday will make space travel a practical means of transportation.

19. LEM (Lunar Excursion Module).

LEM: OUR FIRST TRUE SPACECRAFT, by Bernard Kovit, in *Space/Aeronautics*, v. 39, no. 3 (Mar 1963) 76–83.

"With a little luck, we'll have LEM (lunar excursion module) on the Moon by '67—and have spent some $375 million on it." The editor reports on the story behind these figures as he discusses LEM's mission and timetable, the vehicle, dynamics, landing gear safety and in-flight maintenance, electric power, environmental control, guidance and navigation, contract scoreboard, touchdown conditions and environment, communications, sensors, propulsion and reaction control, and LEM's future.

20. LITTLE JOE II.

LOW-COST LAUNCH VEHICLES FOR SUBORBITAL TESTS, by J. B. Hurt and N. L. Wener, in *Missiles and Space*, v. 10, no. 12 (Dec 1962) 14–16.

This country needs a versatile and reliable low-cost booster for accomplishing high-

altitude, suborbital testing of machines and man-carrying vehicles before they are thrust into orbit or toward some distant heavenly body. This problem was recognized by NASA early in Project MERCURY, and a simple, unguided boost vehicle called LITTLE JOE was created. For the APOLLO program, the Manned Spacecraft Center of NASA envisioned a greater role for a suborbital test booster. This booster, named LITTLE JOE II, now being designed, is discussed by the author providing requirements, characteristics, et cetera.

21. MARINER.

APPROACH TO VENUS, in *Spaceflight*, v. 5, no. 1 (Jan 1963) 2–7.

This article, supplied to Spaceflight by the Jet Propulsion Laboratory, California Institute of Technology, outlines the design objectives of the US MARINER II, and considers: the microwave radiometer, infra-red radiometer, magnetometer, the high energy radiation experiment, solar plasma experiment, cosmic dust detector, et cetera.

MARINER I POISED FOR VENUS SHOT, in *Missiles and Rockets*, v. 11, no. 4 (23 July 1962) 32–33.

Program aimed at interplanetary exploration will extend through 1965; six experiments on first flight. Also discusses configuration, power supply, Venus fly-by mission, and computer check. Two diagrams show (1) interplanetary exploration gear and (2) planned trajectory of MARINER I's flight to Venus.

MARINER REVEALS 800F VENUS TEMPERATURE, by Edward H. Kolcum, in *Aviation Week and Space Technology*, v. 78, no. 9 (4 Mar 1963) 30–31.

Planet Venus has a uniform surface temperature of 800F and is surrounded by a dense cloud layer, 17 mi. thick, which has a base temperature of 200F and a top temperature of — 65F, according to measurements made by the MARINER 2 payload. MARINER 2 scanned the Venusian cloud layer three times when it flew past the planet last Dec. 14. The 447-lb. spacecraft provided 129 days of tracking and telemetry information, including 65 million data bits on interplanetary flight and the first direct measurements of the Venus environment. The report was slightly delayed by "cross-talk" on circuit interactions which made data analyses more difficult.

MARINER TO TEST MARS LIFE THEORIES, by William Beller, in *Missiles and Rockets*, v. 10, no. 16 (16 Apr 1962) 31–32.

The Venus and Mars fly-by program—MARINER B—on which NASA wants to spend $74 million in FY 63, may have a spectacular payoff if it verifies recent speculations by an internationally known biologist. The MARINER B, designed to fly on CENTAUR in 1964, will not only be capable of fly-by missions to Mars and Venus—it also will be able to carry a small planetary atmospheric entry capsule. With a chart of "NASA requested funding for MARINER."

MARINER TRIGGERS INTENSIVE ACTIVITY, by Hal Taylor, in *Missiles and Rockets*, v. 11, no. 26 (24 Dec 1962) 16–17.

The success of MARINER II means "the certain go-ahead" on a far more advanced interplanetary exploration program in 1964. Two fly-by missions of both Venus and Mars will be attempted. A total of six MARINER R spacecraft will be built and two launch pads at Cape Canaveral will be utilized. Also discussed are some of the details of MARINER II launch. With photo and diagrams.

MARINER 2, by Irwin Stambler, in *Space/Aeronautics*, v. 38, no. 6.

The MARINER Venus probe posed a double-barrelled design problem for jet propulsion: Not only was it supposed to penetrate farther into space than any previous US vehicle, it also had to be revamped almost at the last minute to half its original weight. This article reports on how this drastic weight reduction was achieved on an overall design of the MARINER 2.

MARINER 2 FLIGHT TO VENUS, by F. L. Barnes and others, in *Astronautics*, v. 7, no. 11 (Dec 1962) 66–72.

How the trajectory analysis behind this spacecraft's "history-making flight to Venus," which reached the high point of fly-by on Dec. 14, 1962, will become a fundamental operation for future deep-space flights.

MARINER UNLOCKS VENUSIAN MYSTERIES, in *Missiles and Rockets*, v. 12, no. 1 (7 Jan 1963) 16.

Results of "historic" flight of MARINER II include evidence that there is no trace of a magnetic field and that radiation is not intense enough to threaten the safety of space travelers.

22. MERCURY.

THE ASTRONAUTS, by Martin Caidin. New York, E. P. Dutton, 1961. 224 p.

The story of Project MERCURY—America's Man-in-Space-Program. Among the subjects covered: NASA and Project MERCURY; selecting the men; the seven astronauts; animals in space research; ATLAS—the booster rocket; the MERCURY capsule; and training for space. The book covers the flight of Alan B. Shepard (and also of Yuri Gagarin). Many photos and other illustrations.

JOHN H. GLENN, ASTRONAUT, by Lt. Col. Philip N. Pierce and Karl Schuon. New York, Franklin Watts, Mc., 1962. 208 p.

Biography followed details of Glenn's part in the MERCURY Project; including his training as an astronaut and his Friendship 7 flight. Includes transcript of Lt. Col. John H. Glenn's message to the Joint Meeting of Congress, 26 Feb. 1963, chronology of MERCURY test launchings, and glossary of space terms.

MA–8 SHOT MAY BE EXTENDED TO 7 ORBITS, in *Space Technology International*, v. 5, no. 3 (July 1962) 11–15.

How the results of Carpenter's three-orbit MA–7 flight would determine whether the next mission should be expanded. With two pages of photos showing the MERCURY team supporting astronaut Carpenter during his flight.

MA-9 EXPERIMENTS VITAL TO RENDEZVOUS, by George Alexander, in *Aviation Week and Space Technology*, v. 78, no. 3 (21 Jan 1963) 55 plus.

How scientific experiments planned for the ninth MERCURY test flight, tentatively scheduled for early Spring, reflect increasing emphasis at the Manned Spaceflight Center on the collection of empirical data for the development of rendezvous techniques.

NEXT ASTRONAUT MAY SPEND 3 OF 6 ORBITS IN DRIFT FLIGHT, by Edward H. Kolcum, in *Space Technology International*, v. 5, no. 3 (July 1962) 16–20.

Expansion of the MERCURY mission to six orbits—three of them in drifting flight—gained momentum as "analyses of data from the Aurora 7 flight of Lt. Cmdr. Scott Carpenter continued to confirm the overall success of the second U.S. manned three-orbit mission." The author reviews various aspects of the three-orbit mission, such as fuel-consuming maneuvers, re-entry fuel consumption, et cetera. With photos.

ONE STEP CLOSER TO MOON LANDING, in *U. S. News and World Report*, v. 52, no. 23 (4 June 1962) 42–45.

This report shows how "important new knowledge for man's conquest of space . . . . [came] out of astronaut Carpenter's three-orbit flight. Even the suspenseful climax—when Carpenter's fate was in doubt—is yielding valuable information to spaceman. Next: more single-pilot orbits, then orbits by teams. Later: Americans in flight to the Moon."

RESULTS OF THE FIRST UNITED STATES MANNED ORBITAL SPACE FLIGHT FEBRUARY 20, 1962. Washington, US Government Printing Office, 1962. 204 p.

Prelaunch activities, spacecraft description, flight operations, flight data, and post-flight analyses presented from a continuation of the information previously published for the two United States manned suborbital space flights conducted on May 5, 1961, and July 21, 1961, respectively, by the National Aeronautics and Space Administration. Illustrated.

SCHIRRA REPORTS ON MA–8 FLIGHT SUCCESS, in *Aviation Week and Space Technology*, v. 78, no. 7 (11 Feb 1963) 55 plus.

Navy Comdr. Walter M. Schirra, Jr. made the third manned US orbital flight on 3 Oct. 1962 in the Sigma 7 spacecraft. This is Comdr. Schirra's pilot report on the six-orbital flight in which he discusses: countdown and boost, orbital flight, relative motion, suit valve increase, cloud coverage, retrofire stability, communications, landing, et cetera.

SPACE FLIGHT NO. 5: WHAT U. S. LEARNED, in *U. S. News and World Report*, v. 53, no. 16 (15 Oct 1962) 67–69.

"The way is now cleared for a fresh U. S. adventure in space—sending an astronaut into orbit around the Earth for a full day. That's the real significance of the Schirra flight in Sigma 7, a near perfect performance that swept away final obstacles."

WE SEVEN, by M. Scott Carpenter and others. New York, Simon and Schuster. 1962. 362 p.

The story of America's astronauts as told by the astronauts themselves (Carpenter, Cooper, Glenn, Grissom, Schirra, Shepard, and Slayton). Photos.

23. MIDAS.

MIDAS FACES RE-ORIENTATION, by James Trainor, in *Missiles and Rockets*, v. 11, no. 3 (16 July 1962) 12.

MIDAS, the Air Force's Missile Defense Alarm System, is currently undergoing a DOD-directed re-orientation and simplification to give it an early operational capability.

24. MINUTEMAN.

ACE IN THE HOLE; THE STORY OF THE MINUTEMAN MISSILE, by Roy Neal. Garden City, N. J., Doubleday, 1962. 189 p.

The author tells the story of MINUTEMAN and "a group of men who fought .... [a] battle to build a missile of a new and different kind. A rocket designed to be hidden and protected in a hole in the ground."

ADVANCED MINUTEMAN DETAILS REVEALED, by James Trainor, in *Missiles and Rockets*, v. 11, no. 16 (1 Oct 1962) 12.

Air Force adds airborne control center launch ability, redesigns second stage for more range and greater payloads.

HOW THE MODERN MINUTEMAN GUARDS THE PEACE, by James Atwater, in *Saturday Evening Post*, v. 236, no. 5 (9 Feb 1963) 65–69.

The story of how "airmen and missiles go underground .... [and are] as ready as a shotgun shell."

MINUTEMAN GOES OPERATIONAL, by Richard van Osten, in *Missiles and Rockets*, v. 11, no. 25 (17 Dec 1962) 14.

An average of about one MINUTEMAN ICBM per day will be turned over to Strategic Air Command launch crews during 1963—"if the present rate of effort continues." The ICBM activation is slated to take place at five SAC bases. Discusses the simplicity and compactness of the MINUTEMAN system.

MINUTEMAN MANAGEMENT .... THE VIEW FROM THE TOP, by Philip Geddes, in *Aerospace Management*, v. 5, no. 5 (May 1962) 36–40.

The author writes about a taped interview with Brig. Gen. Sam Philips concerning the management of MINUTEMAN to its near operational status.

25. NIKE-ZEUS.

DEFENSE IN NUCLEAR WAR, by Brig. Gen. John G. Zierdt, in *Ordnance*, v. 47, no. 256 (Jan–Feb 1963) 418–421.

Our NIKE ZEUS antimissile missile, while still under development, has come a long way since its inception and now has the capability of intercepting and destroying hostile ballistic weapons in flight. The author describes the problems encountered in perfecting the NIKE ZEUS and its potential role in protecting this country from thermonuclear attack.

IS THERE A DEFENSE AGAINST THE ICBM? NIKE-ZEUS: SUSPENDED SENTENCE BEFORE TRIAL, in *Interavia*, v. 17, no. 8 (Aug. 1962) 1016–1021.

A review of the efforts put in by the American industrial concerns and government agencies which have cooperated in the NIKE-ZEUS missile system, the most complex to date. With photos, sketches, and charts.

PERT IN THE NIKE-ZEUS, by Maj. R. L. Bryant, in *Aerospace Management*, v. 6, no. 1 (Jan 1963) 20–24.

This article explains how PERT (Program Evaluation and Review Technique) was, and is being applied to the NIKE-ZEUS R & D program. It tells what applications are planned for the near future. PERT received its trial run in the Army on project PRESS (Pacific Range Electromagnetic Signature Study), with enthusiastic results which prompted the application of PERT to ZEUS.

26. NIMBUS.

NIMBUS SPACECRAFT SYSTEM, by Rudolf Stampfl and Harry Press, in *Aerospace Engineering*, v. 21, no. 7 (July 1962) 16–28.

Object of Project NIMBUS is to provide a capability for continuous satellite observation for application to weather anlyses and forecasting. Designed to meet this objective and now under construction, the spacecraft and related ground systems designed are detailed. Basic measurements to be obtained include global television picture coverage of the daytime cloud cover and measurements of the Earth's infrared radiation, the reflected radiation, and the Earth's heat balance. This paper discusses the fundamental criteria and conditions that formed the basis for the NIMBUS spacecraft design and describes the characteristics of the NIMBUS spacecraft and its major subsystems.

NIMBUS TO TEST 'POOR MAN'S WEATHER STATION', by William Beller, in *Missiles and Rockets*, v. 11, no. 26 (24 Dec 1962) 24–25.

A satellite weather station transmitting pictures of local moontime cloud-cover to every spot on Earth is expected to come out of an experiment designed for the NIMBUS meteorological satellites. Recent successful ground tests of the system, called Automatic Picture Transmission Subsystem (APT), show it is ready to be tried out on an orbiting vehicle. Although a TIROS satellite was chosen for the preliminary flight-test job, the better test of APT will come in Fall of 1963 when it goes aboard a NIMBUS on its first scheduled launch.

27. OAO (Orbiting Astronomical Observatory).

DESIGNING LONG-LIFE UNMANNED SATELLITES, by F. E. Xydis, in *Aerospace Engineering*, v. 21, no. 9 (Sept 1962) 84–85 plus.

A technical description of NASA's Orbiting Astronomical Observatory (OAO), showing how, "with achievable reliabilities, there is no need or place for man" on certain long-term space missions.

28. OGO (Orbiting Geophysical Observatory).

THE OGO SATELLITES, by Irwin Stambler, in *Space/Aeronautics*, v. 39, no. 2 (Feb 1963) 70–77.

The OGO family of satellite observatories is bringing us very close to one of the basic shapes of scientific space exploration: a basic box structure, simple and flexible at the same time, to which experiment packages for a variety of missions can be added in a great many combinations. This article reviews the special problems raised by this "streetcar" concept of satellite, showing how the requirements of a wide range of experiment packages set the basic conditions for attitude control, material selection, thermal design, and the like. In addition, details are given on the novel methods devised by STL to meet the special needs of a short-run satellite production.

29. ORION.

PROJECT ORION DECISION IMMINENT. by Frank G. McGuire, in *Missiles and Rockets*, v. 11, no. 18 (29 Oct 1962) 28 plus.

Decision on Project ORION—the nuclear-bomb-powered rocket—as a Department of Defense development program appears "imminent." ORION, a four-year-old research program funded at about $2-million annually, "has been a virtually forgotten attempt to develop a space vehicle with a 100-ton payload." Includes discussion on: the policy decision; Air Force attempts to further Project ORION; how ORION works.

30. OSO (Orbiting Solar Observatory).

OSO I UNCOVERS NO NEW HAZARDS FOR LUNAR, INTERPLANETARY FLIGHT, in *Missiles and Rockets*, v. 10, no. 24 (11 June 1962) 13.

America's first Orbiting Solar Observatory (OSO) turned up no new roadblocks to manned space flight to the Moon and other planets. Opportunity for additional information will be provided in the near future by OSO II.

31. PERSHING.

DESIGN OF THE PERSHING MISSILE, by Robert W. Cuthill, in *Ordnance*, v. 47, no. 253 (July–Aug 1962) 56–59.

Many factors enter into the evolution of a modern weapon, including the technical competence of the engineering, procurement, manufacturing, and planning personnel. In addition, a close relationship must be established between the contractor and the military user to make sure that the unique requirements for the proper functioning of the missile under all conditions of storage, transportation, and field use are satisfactorily met.

PERSHING WEAPON SYSTEM, in *Ground Support Equipment*, v. 4, no. 6 (Dec 1962/Jan 1963) 26–28.

The story of how Martin Orlando and the Army Missile Command changed the trend in the weapon system concept, and how ground support equipment dictated the missile design.

32. PLUTO.

AIR FORCE SEEN OKAYING PLUTO TESTS, in *Missiles and Rockets*, v. 11, no 1 (2 July 1962) 14 plus.

"The Air Force apparently will give the Atomic Emergy Commission a go-ahead for ground-testing its $600-million Project PLUTO nuclear ramjet—designed to power the SLAM missile. This means the supersonic low-altitude missile could be flight-tested in 1966. The Navy has also asked the AEC to study possible configurations which could be launched from POLARIS submarines."

33. POLARIS.

AMERICAN ROCKET-CARRYING ATOMIC SUBMARINES. Amerikanskie atomnye podvodnye lodki-raketonostsy, by Capt. T. Kirillow, in *Mirovaia Ekonomika i Mezhdunarodnye Otnoshennia*, no. 10 (Oct 1962) 123–126. In Russian.

Soviet view of the strategy that prompts the United States to build POLARIS submarines, the effectiveness of the POLARIS missiles, and the extent of the POLARIS program. Tries to show that the POLARIS missile is "inaccurate" as compared to similar Soviet missiles, and that the Red Navy is equipped with "superpowered" nuclear submarines capable of operating at high speeds and great depths and over long periods of time in the most remote areas.

POLARIS EFFECTIVENESS — INCREASED THROUGH SHIPBOARD TRAINING, by D. M. Estabrook, in *Missiles and Space*, v. 10, no. 6 (June 1962) 22–24.

One of the main advantages of modern nuclear-powered submarines is capability for prolonged submerged cruises. This has produced the problem of retaining missile launching proficiency without conducting full exercise firings. The personnel operations involved in SSBN POLARIS launchings demand considerable skill and judgment in the complex fire control equipment, launching equipment, and other devices associated with missile countdown procedures. The author discusses the design of a suitable shipboard training system.

POLARIS TRANSPORTING, by John Sherbet, in *Ground Support Equipment*, v. 4, no. 4 (Aug/Sept 1962) 19–21.

How handling, stowing, and transporting POLARIS missiles by the US Navy resupply ships is a vital link in weapons system support.

34. RANGER.

ENGINEERING ASPECTS OF THE RANGER PROJECT, by J. D. Burke, in *Military Engineer*, v. 54, no. 362 (Nov–Dec 1962) 404–405.

The RANGER Project is the first attempt by the US to make close-up measurements and to land equipment on the Moon. The system design is briefly discussed including some of the most important early engineering design decisions which were made in planning this project. Future plans and goals are touched on.

35. RELAY.

NASA'S RELAY SPACECRAFT, by Raymond M. Wilmotte, in *Aerospace Engineering*, v. 21, no. 8 (Aug 1962) 62–63 plus.

A description of the design of the RELAY spacecraft built and tested in simulated space environment is given. Powered by solar cells, the spacecraft will relay signals received at

2 Kmc and retransmit them at 4 Kmc for television and voice between the US and Europe and between the US and South America.

[PROJECT RELAY], in *Signal*, v. 17, no. 2 (Oct 1962) 6–8.

This report consists of the following three papers: ANOTHER STEP IN SATELLITE COMMUNICATIONS; DOMESTIC AND FOREIGN GROUND STATIONS FOR RELAY; and CLOSE LOOK AT U. S.—BRAZIL LINK.

36. REBOUND.

REBOUND MAY CARRY MIXED LOADS OF COMSATS, by Michael Getler, in *Missiles and Rockets*, v. 10, no 22 (28 May 1962) 18 plus.

NASA's passive communications satellite Project REBOUND now scheduled for a 1964 launching could carry a mixed load of satellite types into orbit. In REBOUND the space agency will attempt to launch a multiple load of passive ComSats aboard a single ATLAS-AGENA booster and disperse them in orbit to form a workable passive satellite communication network.

37. ROVER.

ROVER SLIPS EXTRA 14–16 MONTHS, by Frank G. McGuire, in *Missiles and Rockets*, v. 12, no. 10 (11 Mar 1963) 14–15.

Further slippage of the ROVER nuclear rocket program by 14 to 16 months has been laid to engineering and materials problems in the Kiwi test series of reactors. There is now an increased possibility that the nation's highest priority, a DX priority, will be assigned to the program to keep the slippage from seriously affecting nearly all post-APOLLO space flights. Next hot firing of a Kiwi-series reactor is now expected next year in the aftermath of the Kiwi B4–A firing last Nov 30, which resulted in significant damage to the reactor fuel elements, insulation, and other parts. That reactor was the program's "preferred design."

38. S–66.

S–66 WILL CHART THE IONOSPHERE, by William Beller, in *Missiles and Rockets*, v. 11, no. 6 (6 Aug 1962) 22–24.

How the first major step toward a global map of the ionosphere is scheduled for early next year when the S–66 Polar Beacon Ionosphere Satellite goes into orbit. Discusses: the low cost of the project, its history, the scientific goals, radio transmissions, Laser tracking, structure, attitude control, et cetera.

39. SATURN.

KEEP TO "ECONOMICAL" SPACE FLIGHT: SATURN HARDWARE AND REUSABLE BOOSTERS, by J. T. Gordon and W. H. Siegried, in *Space/Aeronautics*, v. 93, no. 3 (Mar 1963) 93–95.

The cost of space flight can be brought down sharply if we make full use of the hardware we are planning and if we develop reusable boosters. To bolster their case, the author's review the growth potential of the SATURN, which could be used for boosters to succeed the ATLAS-CENTAUR, for simple and complex space stations to be used for test flights in preparation for manned planetary flight, and for planetary missions themselves. In their analysis of re-usability they examine the possibility of recovery by inflatable drag cones and point up the advantages of nuclear boosters.

LAUNCHING THE MOON ROCKET, by Kurt H. Debus, in *Astronautics and Aerospace Engineering*, v. 1, no. 2 (Mar 1962) 20–32.

LC–39 complex of launch facilities for advanced SATURN C–5 marks major advance over past operations with combination of automatic checkout in industrial-like environment, movement of ready vehicles to multipad complex, and remote control of launch itself. Since the problems related to launch operations are LOC's (Launch Operations Center, located at the Atlantic Missile Range) responsibility, the scope of this article is limited to concepts, techniques, and facilities for the launch of the SATURN-APOLLO space vehicle.

40. SERGEANT.

ARMY FIRES SERGEANT AS FIELD USE NEARS, by Erwin J. Bulban, in *Aviation Week and Space Technology*, v. 77, no. 20 (12 Nov 1962) 82–83 plus.

How first firing of a tactical configuration Sperry SSM–A–21 SERGEANT surface-to-sur-

face missile at White Sands Missile Range, N. M., under complete control of a US Army artillery unit culminated in the ballistic missile impacting in the target CEP (circular error probability) after a maximum-range flight of slightly over 74 naut. mi. Discusses: weapon characteristics, nuclear posture of the weapon, system operation, missile firing, et cetera. With photos.

PUSHBUTTON MISSILE, by John J. Leete, in *Ordnance*, v. 47, no. 256 (Jan-Feb 1963) 471–474.

SERGEANT, the Army's solid-fueled, inertially guided, field-artillery weapon, is said to have pushed modern science to its limit. The article explains how maximum reliability, extreme mobility, and fast reaction time are achieved by an integral maintenance and support plan which enables troops with only a few weeks of training to check and replace faulty components in the field.

SERGEANT, in *Army*, v. 13, no. 5 (Dec 1962) 31–35.

The story of SERGEANT as "it makes its debut" and which is considered "more reliable, more mobile, faster firing." Discusses: Tactical organization and control, details of the missile and its support equipment, third echelon maintenance, and the firing procedure.

SERGEANT—"SHOOT AND SCOOT: ARTILLERY MISSILE SYSTEM READY FOR TACTICAL MISSION," in *Western Aerospace*, v. 42, no. 12 (Dec 1962) 20–22.

Mobility and simplified ground support equipment are keys to SERGEANT's tactical role.

SERGEANT SUCCESS INDICATES READINESS, by Charles D. LaFond in *Missiles and Rockets*, v. 11, no. 18 (29 Oct 1962) 16–17 plus.

The first tactical firing in Oct. of the SERGEANT missile by US Army artillerymen had demonstrated the weapon's readiness for operational overseas deployment in 1963. This solid-fuel missile, with a 25–75 nautical-mile-range, is to replace the more cumbersome CORPORAL. This report includes operational philosophy, deployment history, the launching station, checkout and repair, and the countdown.

SERGEANT TAKES THE FIELD, in *Interavia*, v. 18, no. 2 (Feb 1963) 201–203.

The SERGEANT missile is almost operational at a total cost to date of about $500 million. Deployment of US Army SERGEANT units abroad is due to start early this year, the first destination "most probably being Germany." Interest from other NATO countries is reported. SERGEANT is expected to remain operational for the best part of a decade, "and there is at present no known provision for a follow-on program." The article discusses: the missile; ground handling; target acquisition, survey, and fire direction; firing; field organization; mobility and deployment; supply; and maintenance. With charts, photos, and sketches.

41. SKYBOLT.

MOST MOBILE MISSILE, by George J. Geiger, in *Ordnance*, v. 47, no. 255 (Nov–Dec 1962) 294–297.

The Air Force's SKYBOLT 1,000-mile-range nuclear-armed weapon rides under the wings of the B–52 and can be sent ahead at a moment's notice to knock out enemy defenses before the mother ship moves in to deliver an H-bomb attack. The author reviews the development and capabilities of this "modern 'bolt out of the blue.' "

42. SLAM.

FAST, LOW, AND DEADLY . . . . SLAM! by Vern Haugland, in *Ordnance*, v. 46, no. 252 (May–June 1962) 756–759.

"For a long time military tacticians have dreamed of an aerial system that can operate at very great speeds, yet hug the contour of the earth to avoid setting off radar alarms." The author tells how the development of the SLAM supersonic low-altitude, nuclear-powered missile system may be the solution to this vital problem of undetected attack.

43. SNAP.

AEC EMERGES AS NEW SPACE AGENCY, by William Beller, in *Missiles and Rockets*, v. 11, no. 13 (24 Sept 1962) 14–15.

The Atomic Energy Commission emerges as a new space agency during hearings held Sept. 13, and 14, by a subcommittee of the

Joint Committee on Atomic Energy. "This became evident when government witnesses testified that tentative agreement had been reached giving AEC responsibility for developing high-power nuclear-electric systems for space vehicles." First system involved is SNAP–50/SPUR, planned for operation early in 1970.

RADIONUCLIDE POWER SOMETHING NEW UNDER THE SUN, by Jerome G. Morse, in *Interavia*, v. 17, no. 10 (Oct 1962) 1301–1303.

Conversion of the decay heat of radionuclides to electrical energy is "something new under the sun." Thermoelectric converters utilizing nuclear heat are powering transmitters and instrumentation in two US Navy Transit satellites, and may soon be used in probing secrets of the lunar surface, vapor shrouded Venus, and in space probes going away from the sun. Developed by Martin Marietta Corporation's Nuclear Division under contract with the US Atomic Energy Commission, the radiation-powered generators are called SNAP's—for Systems for Nuclear Auxiliary Power.

SNAP SAFETY TESTS SLATED FOR ORBIT, by Frank G. McGuire, in *Missiles and Rockets*, v. 11, no. 19 (4 Nov 1962) 38–39.

At least four SNAP devices will be orbited by the Air Force Special Weapons Center beginning 1963 in safety tests to investigate the burn-up characteristics of nuclear power packages during re-entry. Two SNAP–2 and two SNAP–10A units will be used in the upcoming "SNAPSHOT" phase of the program. AGENA to carry the re-entry package. Ballistic flight details, and other studies under way.

44. SURVEYOR.

THE SURVEYOR SPACECRAFT MISSION, by Leo Stoolman, in *Missiles and Space*, v. 11, no. 1 (Jan 1963) 18–19 plus.

The task of the SURVEYOR spacecraft, to be launched in 1964, is to solve mysteries of the nature and origin of the Moon and to arm our astronauts with foreknowledge of conditions essential to their safe landing and return. This unmanned spacecraft is designed to soft-land a payload of instruments, conduct experiments, and transmit the results back to Earth. The author discusses: basic design, scientific payload, the spacecraft vehicle, flight control, telecommunications, propulsion, electrical power supply, and support equipment.

TWELVE SURVEYORS NOW PLANNED FOR MOON EXPLORATION, by William Beller, in *Missiles and Rockets*, v. 10, no. 23 (4 June 1962) 21–22 plus.

Despite some pressure to push PROSPECTOR into the SURVEYOR program, NASA maintains it will keep SURVEYOR as is. NASA is changing PROSPECTOR into a logistics supply vehicle to support the manned lunar spaceflight program. The two versions of SURVEYOR are scheduled to be launched by an ATLAS-CENTAUR in 1964. SURVEYOR A is designed for a soft landing on the lunar surface where the 200- to 300-lb. instrument package will proceed to view and experiment the lunar terrain and soil. SURVEYOR B—an adaptation of A—will be put into a near-polar orbit around the Moon where the spacecraft will take television pictures of the body in addition to making radiation and other physical measurements of the environment. With a report on instrumentation.

45. SYNCOM.

CONTROL OF THE 24-HOUR SYNCOM SATELLITE, by Donald D. Williams, in *Missiles and Space*, v. 11, no. 2 (Feb 1963) 14–15 plus.

SYNCOM is the lightweight, synchronous communications satellite developed for NASA. This article describes the method of spin stabilization used to achieve a high altitude, synchronous orbit and the technique by which the satellite's attitude can be oriented.

46. TITAN.

MANNED SPACE FLIGHT, by Vern Haugland, in *Ordnance*, v. 47, no. 256 (Jan–Feb 1963) 430–434.

Up to the present time our man-carrying satellites have been governed mainly by the laws of ballistics, but the X–20 DYNA-SOAR delta-winged glider will be able to maneuver during return from orbit and travel through the atmosphere in controlled flight to a safe landing on earth. The author states that the

3-stage TITAN III launch vehicle will be able to place 13,000 pounds in orbit.

SIMPLICITY, DUPLICATION WILL GIVE TITAN 2 MANNED FLIGHT CAPABILITY, by George Alexander, in *Space Technology International*, v. 5, no. 4 (Oct 1962) 34–38.

Simplicity of design, redundant malfunction detection system and painstaking manufacturing procedures are the major characteristics of the conversion of the Air Force TITAN 2 ballistic missile to a man-rated launch vehicle for NASA's GEMINI two-man spacecraft. Discusses such aspects as malfunction detection, the radio command unit, the primary system, roll capability, sequence, et cetera.

TITAN I TURNOVER QUICKENS ICBM BUILDUP, in *Missiles and Rockets* v. 10, no. 18 (30 Apr 1962) 16–17 plus.

How SAC accepted the first hardened operational squadron, TITAN I, on 18 April at Lowry AFB, how another nine-missile squadron will go operational, and how SAC faces the task of increasing reliability rating of the weapon system. Also a description of the system's complex.

TITAN 3 LAUNCHES TO BEGIN IN FALL, 1964, by George Alexander, in *Aviation Week and Space Technology*, v. 78, no. 8 (25 Feb 1963) 27–28.

Discussion of Air Force plans to launch 17 TITAN 3 boosters, starting in Autumn of next year, during a 45-month flight test program which will develop and man-rate this military space vehicle.

TITAN III PLAN AWAITS DOD APPROVAL, by James Trainor, in *Missiles and Rockets*, v. 10, no. 20 (14 May 1962) 35–36.

Development costs of the TITAN III Standardized Space Launch System are expected to be "in the $1 billion range." TITAN III (AF designation, Program 624A) will provide a reliable and short-reaction-time vehicle for military space missions over "the next decade." One of the principal advantages of the standardized TITAN III space booster will be its flexibility. The core of the vehicle will be the TITAN II—modified to provide additional structural strength and an air-start capability.

TITANS ON FIRING LINE: NEW MUSCLE FOR U. S., in *U. S. News and World Report*, v. 52, no. 18 (30 Apr 1962) 68–70.

"For U.S., this is 'the year of the big payoff' in missiles. You see why in this look at a mighty array of long-range weapons that are now in place—ready to fire. And more will be ready soon."

47. TRANSIT.

DEVELOPMENT OF A NAVIGATIONAL SYSTEM SATELLITE, by M. A. Schreiber, in *Signal*, v. 17, no. 4 (Dec 1962) 31–36.

The Sept., 1960, issue of Signal included an article entitled, THE TRANSIT NAVIGATION SYSTEM, which described its basic concepts, and historical and scientific origin concluding in a description of the first satellites and their launchings. During the development program the acquisition of new knowledge of the Earth's geodesy, the evolution of new satellite system hardware and techniques "have evoked considerable and continuing interest." The present article attempts to describe some of the design and engineering problems encountered in the hardware development and their solutions, and are restricted to the satellite (payload); the other essential elements of the system are beyond the scope of this article.

48. VELA HOTEL.

VELA HOTEL SATELLITES IN FINAL HARDWARE STAGE, by Irwin Stambler, in *Space/Aeronautics*, v. 37, no. 6 (June 1962) 54–56.

"Of all the groping steps toward disarmament, a nuclear test ban is still the one most likely to succeed. It's mainly for this reason that there has been no slackening in the VELA program, despite the resumption of atomic testing." The author reviews the satellites around which VELA HOTEL will be built, the system for detecting nuclear explosions in outer space. It discusses the detection requirements of such surveillance, the detector designs that are being tried out, and the problem of interfering natural radiation that these detectors must overcome. The orbits to be used by the VELA HOTEL satellites also are covered.

C. NASA: Activities and Programs.

1. Miscellaneous Aspects.

FIFTH SEMIANNUAL REPORT TO CONGRESS: OCTOBER 1, 1960 THROUGH JUNE 30, 1961. Washington, U.S. National Aeronautics and Space Administration. 1962. 244 p.

Includes information on: manned space flight; satellite applications; scientific satellites and sounding rockets; unmanned lunar and interplanetary programs; tracking and data acquisition; launch vehicles development; propulsion and power generation; satellite development; research primarily supporting aeronautics activities; space activities; space activities research; special research projects; life science programs; construction of facilities; international programs; organizational development; procurement, contracts, and grants; financial management; personnel; other activities. With many illustrations.

[NASA AND U.S. SPACE PROGRESS], in *Missiles and Space*, v. 10, no. 10 (Oct 1962) 10–34 plus.

Almost this entire issue is devoted to articles presenting a "summary report" on facilities, programs, and future plans of NASA. The following are some of the reports: NASA'S PROGRESS; A MESSAGE FROM NASA ADMINISTRATOR JAMES E. WEBB; STATUS AND STRUCTURE OF THE NATIONAL SPACE PROGRAM; SHOCK TUBE STUDIES OF APOLLO REENTRY; ADVANCED METALS AND ALLOYS FOR THE U.S. SPACE PROGRAM; MERCURY CAPSULE REACTION CONTROL PROPULSION SYSTEM; F–1 ROCKET ENGINE DEVELOPMENT; SATURN BOOSTER FUEL AND OXIDIZER DUCTING: THE GODDARD RANGE AND RANGE RATE TRACKING SYSTEM.

NASA BIOSCIENCE DUTIES PINPOINTED, by Heather M. David, in *Missiles and Rockets*, v. 12, no. 5 (4 Feb 1963) 32–33.

How NASA's definition of responsibilities is aimed at the elimination of duplication among the related offices dealing with (1) manned spaceflight, (2) advanced research and technology, and (3) space sciences.

NASA GROUND OPERATIONAL SUPPORT SYSTEM FOR MANNED SPACE PROGRAMS, by R. L. Schroeder and John Zvara, in *Missiles and Space*, v. 11, no. 2 (Feb 1963) 16–18 plus.

Design considerations are reviewed in light of mission phases, near Earth phase, continuous coverage, trajectory computation, pullout, control program, Earth return trajectories, problem areas, maneuver potential, data acquisition, data transmission, and centralized control.

NASA INSTITUTE DRAWS TOP SCIENTISTS, by Michael Getler, in *Missiles and Rockets*, v. 10, no. 17 (23 Apr 1962) 16–17.

How the Institute for Space Studies is solving some of NASA's theoretical problems by using outstanding professors and students recruited in the US and abroad.

NASA LEANING TO LUNAR-ORBIT RENDEZVOUS, by Hal Taylor, in *Missiles and Rockets*, v. 10, no. 24 (11 June 1962) 12–13.

"NASA is moving toward a decision to select lunar-orbital rendezvous for the first American manned landing on the Moon." Many top officials are reported in favor of a change-over from Earth-orbit plans.

NASA MISSIONS THROUGH 1980 OUTLINED, in *Missiles and Rockets*, v. 11, no. 20 (12 Nov 1962) 14.

Some details of possible future NASA space missions through 1980—including a Mars station and manned satellites orbiting Jupiter and Mercury. With chart of some space exploration possibilities. Also budget breakdown.

NASA OFFERS NEW FAST-ACTION SERVICE, by William Beller, in *Missiles and Rockets*, v. 11, no. 2 (9 July 1962) 35–36.

A broad information service, based on an IBM 1401 computer and designed to give space scientists and engineers fast access to needed technical reports, is getting under way at NASA. A biweekly journal operating on short deadlines provides abstracts and indexes in depth of technical reports relevant to space and aeronautics that NASA continuously acquires on a worldwide basis.

NASA SEEKS SPACE STATION PARAMETERS, by Irving Stone, in *Aviation Week and Space Technology*, v. 78, no. 13 (1 Apr 1963) 70–73.

A series of studies to establish the framework of technical requirements for a manned earth-orbiting space station and its associated logistics is being supported by NASA's Manned Spacecraft Center. Spacecraft projections indicated as common denominators for all the studies include radial-module and cylindrical arrangements. Included in the group of studies are these successive efforts: configuration analysis, operations and logistics study, environmental control and life support system study, and on-board electrical power system study.

NASA-USAF INTERFACE—WILL IT BE A TWO-WAY STREET? by William Leavitt, in *Air Force*, v. 45, no. 9 (Sept 1962) 71–74 plus.

"There is a significant opportunity to attain vitally needed USAF military space capabilities through truly mutual cooperation between the aerospace arm and the civil agency. But the opportunity requires (1) the Department of Defense's willingness to risk funds and energy—and (2) NASA's recognition that its programs must serve national—including military—needs."

THE NATIONAL SPACE PROGRAM. PHASE II: IMPLEMENTATION OF THE NATIONAL AERONAUTICS AND SPACE ACT OF 1958, by Mary Stone Ambrose. Washington, The American University, 1961. 303 p. (Unpublished M.A. seminar report.)

Phase I of this study covered the legislative history with emphasis on the public record of the events leading to the passage of the Space Act and a review of the major issues involved. This Phase II covers the implementation of the Space Act and is primarily a survey of the organization and functions of NASA with emphasis on the budgeting and programming aspects, during the first two years of its operations beginning 1 Oct. 1958. Partial contents: DEVELOPMENT AND GROWTH OF NASA SPACE CAPABILITIES; NASA—ITS ORGANIZATION AND FUNCTIONS; SUPPORTING ACTIVITIES; NASA PROGRAMMING AND EARLY BUDGETING; NASA'S LONG-RANGE PROGRAM AND BUDGET FOR FISCAL YEAR 1961; COORDINATION OF AERONAUTICAL AND SPACE ACTIVITIES; et cetera. With selected bibliography and various appendices.

NERVE CENTER AT NASA, by Roland Frambes, in *Aerospace Management*, v. 6, no. 2 (Feb 1963) 54–56.

An urgent need to transform "mountains" of raw data into usable information in the J–2, and SATURN C–5 projects will "spawn" a computerized data-management center at NASA's George C. Marshall Space Flight Center. IBM and NASA will develop new machines and data handling techniques from this prototype center.

REACHING FOR THE MOON: NASA's TEN YEAR PROGRAMME, in *Interavia*, v. 17, no. 10 (Oct 1962) 1278–1284 plus.

This report is prefaced by a review of the present Soviet program and their plans to 1967. The report on NASA's long-range program details: plans for the near future with MERCURY, the APOLLO program, SATURN boosters, the whole family of carrier rockets which are the key problem, "VIA MERCURY AND GEMINI TO APOLLO," robots for advancing lunar reconnaissance, Venus and Mars exploration, communications and weather satellites, basic space research, et cetera. With photos, sketches, and charts.

SELLING TO NASA. Washington, U.S. Government Printing Office, 1962. 32 p.

NASA's mission and activities; how NASA buys; contracts NASA may use; provisions for patents; and directory of NASA centers which includes description of projects and activities.

SIXTH SEMIANNUAL REPORT TO CONGRESS, JULY 1 THROUGH DECEMBER 31, 1961. Washington, National Aeronautics and Space Administration, 1962. 184 p.

"This report reveals evidence of the constructive impact of the decision, made earlier in the year and supported . . . . by the Congress, to accelerate our space efforts." The accomplishments and progress of NASA are summarized in part one, and part two discusses them in detail in all areas such as: manned space flight; satellite applications; geophysics and astronomy programs; unmanned lunar and

interplanetary programs; tracking and data acquisition; launch vehicle programs; propulsion and power generation; space and aeronautics research activities; life science programs; construction of facilities; international programs; et cetera.

SPACE CONTROL CENTER TO OPEN IN 1964, by Barry Miller, in *Aviation Week and Space Technology*, v. 77, no. 26 (24 Dec 1962) 52–53 plus.

New multi-million dollar Integrated Mission Control Center (IMCC) which will directly control and command NASA's manned spacecraft flights, beginning with GEMINI rendezvous missions, is expected to begin limited operations in Houston by mid–1964. IMCC will direct the Recovery Control Center (RCC), which will be the control points in the ground support of spacecraft re-entry and landing.

SPACE ENGINEERING—1962, by James E. Webb, in *Military Engineer*, v. 54, no. 360 (July–Aug 1962) 233–235.

The US National Launch Vehicle Program and rocket power of launch vehicles, support facilities (test stands, launch facilities), and other NASA projects.

[SPECIAL REPORT: NASA TELLS INDUSTRY ITS PLANS FOR THE NEXT DECADE], in *Missiles and Rockets*, v. 12, no. 7 (18 Feb 1963) 14–18.

Manned Spaceflight—Some Decisions Due This Year; Space Sciences—VOYAGER, Solar Probe Studies Next; Tracking—Work Starting Soon on New Antenna Net; Advanced Research —14 New Facilities Funded; Applications—Communications, Weather Stressed.

TOWARD THE NEW HORIZONS OF TOMORROW, by Hugh L. Dryden, in *Astronautics*, v. 8, no. 1 (Jan 1963) 14–19.

First Annual American Rocket Society Lecture presented on 16 Nov. 1962 at the ARS 17th Annual Meeting and Space Flight Exposition, Pan Pacific Auditorium, Los Angeles, Calif., in which the Deputy Administrator, NASA, discussed the general objectives of the National Aeronautics and Space Act and where we stand.

U.S. MAPS PLAN FOR 'QUIET SUN YEAR,' in *Missiles and Rockets*, v. 11, no. 3 (16 July 1962) 16–17.

NASA will launch about 300 sounding rockets and 12 satellites as part of the US participation in the International Year of the Quiet Sun. An additional 19 satellites are under consideration as part of the program. The "Year," which officially begins April 1964 and ends December 1965, encompasses a solar low period. 24 countries will participate in the IQSY.

2. Budget and Expenditures.

HOW NASA FUNDS 'FAR OUT' STUDIES, by William Beller, in *Missiles and Rockets*, v. 10, no. 26 (25 June 1962) 40 plus.

The Future Projects Office of NASA's Marshall Space Flight Center's proposals for spending $15 million during FY '63–'64 for contracted research on an exotic line of projects including planetary transportation systems and operations in the Martian environment. With chart indicating proposed research on vehicle subsystems, launch vehicles, orbital systems and orbital operations, lunar transportation systems and operations, lunar base-construction and operations, planetary transportation systems and operations, and Martian systems and operations.

NASA FORESEES $5.5 — $7 BILLION BUDGETS, by Edward H. Kolcum, in *Aviation Week and Space Technology*, v. 77, no. 27 (Mid-Dec 1962) 56–61.

NASA foresees a gradual leveling trend in the amount of money it will receive to conduct the US space program, but the budget anticipated in the immediate future continues to place the space agency in the category of big business. The level of effort during the next decade is expected to range between $5.5 and $7 billion annually and the space market will continue to be highly competitive. Discusses: construction; research, development and operations; headquarters procurement; the Manned Spacecraft Center; Marshall Center; Jet Propulsion Laboratory; the Space Nuclear Propulsion Office; Langley Research Center; Omes Research Center; Goddard Center; Lewis Center; Western Operations; Wallops Station; Flight Research Center; and Launch Operations Center.

NASA REQUESTS BUDGET OF $5.7 BILLION, by Alfred P. Alibrando, in *Aviation Week and Space Technology*, v. 78, no. 3 (21 Jan 1963) 29–31.

Full impact of the APOLLO manned lunar landing program on the national budget is reflected for the first time in the $5.7-billion appropriation requested for civilian space activities in Fiscal 1964. Manned flight and supporting programs account for about $4 billion of the request, or 4% of the national budget. With following statistical charts: Fiscal 1964 NASA Program Breakdown; Fiscal 1964 Manned Space Flight Programs; and NASA Budget History.

PROGRAM BREAKDOWN OF FY 1964 NASA BUDGET, in *Aviation Week and Space Technology*, v. 78, no. 8 (25 Feb 1963) 31–33.

SIX NEW NASA FLIGHT PROJECTS FUNDED, in *Missiles and Rockets*, v. 12, no. 6 (11 Feb 1963) 16–17.

The $891.2-million Fiscal 1964 R & D budget request of NASA's Offices of Applications and Space Sciences includes funds for six new satellite and spacecraft programs: MARINER Mars/Venus lander, advanced OSO among satellites and spacecraft involved. Details of the budget requests of other major projects in both program offices include: RANGER, SURVEYOR, SURVEYOR ORBITER, MARINER, communications satellites, and meteorological satellites.

[SPECIAL REPORT—HOW NASA PLANS TO SPEND $2.9 BILLION FOR R & D IN FISCAL 1963], in *Missiles and Rockets*, v. 10, no. 15 (9 Apr 1962) 12–17 plus.

This issue presents a detailed breakdown of the Fiscal 1963 R & D budget. The budget figures are broken down into the following sections: spacecraft p. 12, satellites p. 14, launch vehicles p. 15, propulsion p. 16, electronics, p. 17, and space power p. 34.

D. Armed Forces.

1. Army.

ARMY HELICOPTERS TO GET NEW MISSILE CAPABILITY, by James Trainor, in *Missiles and Rockets*, v. 11, no. 9 (27 Aug 1962) 15–16.

"Although the super-secret Howze Board report on the Army's tactical mobility requirements over the next decade has not yet been submitted to Secretary of Defense Robert S. McNamara, Army officials have evolved a requirement for a completely new and revolutionary helicopter weapons system .... Certain to expand as the result of the Howze Board recommendations, armament for fixed-wing aircraft will center around missiles—both air-to-air and air-to-surface—optimized for the close support missions and slower speeds of Army aircraft."

[THE ARMY IN 1970. A SPECIAL ISSUE], in *Army Information Digest*, v. 18, no. 2 (Feb 1963) 2–56.

Cyrus R. Vance, Secretary of the Army, in the foreword to this special issue states "What then does the future hold? Certainly an orderly progression of changes and innovations must be accomplished, or the Army will lose its dynamic quality. New and improved weapons and concepts for their employment will require future modifications of organization. It is well for the Army to look ahead to 1970 in this issue of Army Information Digest, not in the attempt to make any actual forecasts or prophecies, but rather as an exercise in analyzing the possibilities open to us." Contents: GUIDELINES FOR THE ARMY OF 1970, by Gen. Earle G. Wheeler; THE ARMY OF 1970, by Gen. Barksdale Hamlett; MAN—THE CRITICAL FACTOR, by Lt. Gen. R. L. Vittrup; R & D LOOKS TO THE SEVENTIES, by Lt. Gen. Dwight E. Beach; THE FIELD ARMY IN 1970, Lt. Gen. R. W. Colglazier, Jr.; and THE NUCLEAR POWERED FIELD ARMY OF THE 1970'S, by Maj. Gen. James B. Lampert.

ARMY MISSILE COMMAND—WHERE COMPETENCE PAYS OFF IN WEAPONS SUPERIORITY, by Maj. Gen. F. J. McMorrow, in *Army Information Digest*, v. 18, no. 1 (Jan 1963) 20–25.

How the Missile Command is a catalyst that brings together science, industry, and the military. "The fruits of this union are advanced missile systems that constantly keep our forces a pace ahead for the protection of the nation and its allies."

FIRST PERSHING BATTALION ACTIVATED, by Reed Bundy, in *Missiles and Rockets*, v. 10, no. 26 (25 June 1962) 23–34.

Details of the first Pershing Battalion [The 2nd Missile Battalion (Pershing), 44th Artillery] of the U. S. Army which was in the process of being activated during June 1962 at Ft. Sill, Oklahoma.

MISSILES FOR THE MISSIONS, by Capt. Richard D. Lawrence, in *Army*, v. 13, no. 1 (Aug 1962) 33–37.

"Out of the vast technological race and within the broad scope of our direct and general fire-support needs, how can we best develop a missile or a family of missiles that will achieve the objectives which cannot be reached with conventional artillery?" We urgently need to reduce, by type, our arsenal of general and direct support missiles. This should be done to correct what may lead to insoluble logistical problems, and to systematize and make as uniform as possible the artillery-man's training and maintenance needs.

MULTIPURPOSE FIELD MISSILES ARE SOUGHT, by George Alexander, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 154–155.

Design of battlefield missiles, which has tended toward development of many diverse, highly specialized systems, is underdoing a gradual shift toward a modular concept. U. S. Army's future procurement of missile systems —and the Army is the principal customer for field use missiles—will be based on the criteria of versatility, modularity and simplicity approaching that of artillery shells. Battlefield missiles soon to phase into service: PERSHING, SERGEANT, REDEYE, MAULER, SHILLELOGH, TOW, and LAW. In early development—LANCE.

SELECTION OF ANTI-TANK MISSILE GUNNERS—STATUS REPORT, 30 JUNE 1962, by Martin F. Wiskoff. Washington, US Army Personnel Research Office, 1963. 12 p. (Technical Research Report 1128).

USCONARC and the Army Missile Team at Fort Benning, Georgia, requested USARPO to assist in selecting men for SS–10/11 training schedules to begin in January 1960 in the interest of improving gunner trainee proficiency. Described are the procedures employed and the findings.

2. Navy.

THE FLEET VERSUS THE BALLISTIC MISSILE, by Capt. Russell S. Crenshaw, Jr., in *U.S. Naval Institute Proceedings*, v. 89, no. 4 (Apr 1963) 34–39.

"Maneuvering at sea against normal reconnaissance, the ship is today relatively safe from attack by ballistic missiles. But what will the Fleet's chances be, the author asks, when the enemy has refined his 'spy-in-the-sky' techniques, and has perfected terminal guidance for ICBM's?"

THE MISSILE SUBMARINE: TOTAL OR PARTIAL DETERRENT? by M. P. Gallois, in *Interavia*, v. 17, no. 5 (May 1962) 570–572.

To detect and destroy simultaneously all the POLARIS-carrying submarines which will figure in the US Navy's inventory seems today an almost impossible task. However, notwithstanding the advantages which the submarine appears to have over the defense, it is not without its drawbacks. The great advantage of the undersea ballistic weapon is the secrecy in which it can shroud its movements. "Although no more than mediocre as a weapon of aggression," the submarine launch platform has advantages in the deterrence of a potential aggressor. Although the missile-launching submarine has "burst" into world strategy and no method of defense against it is yet known, considerable intellectual and material resources will from now on be devoted in solving the problems. "In any event, the more deterrent submarines there are, the longer this arm will retain its remarkable authority."

THE NAVY'S FUTURE ROLE IN SPACE, by Capt. Malcolm W. Coyle, in *US Naval Institute Proceedings*, v. 89, no. 1 (Jan 1963) 85–93.

"By 1973 the Navy will be busy operating 'satellite stations' for communications, meteorological, and navigation purposes. And as today POLARIS is housed in a sea-going launcher, so will most of the great rockets of the future be launched from platforms at sea."

NEW HORIZONS OF NAVAL RESEARCH AND DEVELOPMENT, by Vice Adm. William F. Raborn, in *US Naval Institute Proceedings*, v. 89, no. 1 (Jan 1963) 38–47.

The author describes the progress being made in many fields concerning the Navy, and gives his opinion of what will be the state-of-the-art of naval technology in 1973 as he discusses among others: nuclear power and nuclear weapons, space, strategic systems, et cetera.

3. Air Force.

AIR FORCE INTENSIFIES SPACE CAMPAIGN, by Russell Hawks, in *Missiles and Rockets*, v. 11, no. 13 (24 Sept 1962) 16–17.

The accelerating Air Force drive for manned spaceflight capability was underscored by a series of developments in which hardware plays the major role: disclosure of design details of three Lockheed F–104A jet fighters undergoing conversion for use as spaceflight trainers; unveiling of the full-scale mockup of the X–20 space glider and selection of six pilots to fly the joint AF–NASA DYNA-SOAR vehicle; announcement of TITAN III transtage capabilities; unveiling of a model of the TITAN III, to be a workhorse booster for AF manned space mission; and proposal by Martin Co. that a network of low-altitude nuclear-powered satellites be established to provide instant military communications.

TECHNOLOGICAL SUPERIORITY — IN ALL COMBAT MEDIA, by Lt. Gen. James Ferguson, in *Air Force*, v. 45, no. 4 (Apr 1962) 71–72 plus.

USAF's Deputy Chief of Staff for Research and Technology spells out areas of vitally needed effort if we are to attain the technological supremacy needed for our military space capability. This article includes highlights of the Air Force's Ten-Year Space Plan.

STRATEGIC MISSILES AND BASING CONCEPTS, by Maj. Kendall Russell, in *Air University Quarterly Review*, v. 13, no. 3 (Spring 1962) 69–82.

The Air Force's present emphasis on ICBM weapons is due not so much to their capability to penetrate enemy defenses as to their adaptability to survival measures preceding launch. These survival measures manifest themselves in a variety of basing concepts. The author discusses and highlights the interrelationship of these basing concepts with overall missile force effectiveness.

TITAN I TURNOVER QUICKENS ICBM BUILDUP, in *Missiles and Rockets*, v. 10, no. 18 (30 Apr 1962) 16–17 plus.

How SAC accepted the first hardened operational squadron, TITAN I, on 18 April at Lowry AFB, how another nine-missile squadron will go operational, and how SAC faces the task of increasing reliability rating of the weapon system. Also a description of the system's complex.

U.S. BOMBERS B1–B70, by Lloyd S. Jones. Los Angeles, Aero Publishers, 237 p.

Includes photos and description of various US missiles and missile-carrying aircraft.

USAF KEYS SPACE PLAN TO THREE PROGRAMS, by Edward H. Kolcum, in *Aviation Week and Space Technology*, v. 78, no. 4 (28 Jan 1963) 26–28.

The Air Force has elected to shape its space program around three fundamental projects which include two manned space flight systems designed to extend civilian space vehicle experience to applied military hardware. The Institute of the Aerospace Sciences members were told at their 31st annual meeting in New York that USAF Systems Command sees rendezvous and inspection, space station development and communications satellites as "space programs of prime military necessity." Maj. Gen. Ben I. Funk, Space Systems Division commander, outlined these requirements in a report, stating that the job of his division in 1963 is to take full advantage of existing technology to stress these three programs.

USAF STUDIES U.S. SOVIET SPACE POTENTIAL, in *Aviation Week*, v. 76, no. 10 (5 Mar 1962) 75 plus.

"[Air Force Lt. Gen. James Ferguson, deputy chief of staff for research and technology, told the House Armed Services Committee recently that it will take a concerted national effort to create a military posture adequate to counter the potential threat of the Soviet Un-

ion's military activity in space. In a public statement released after the closed hearing, Gen. Ferguson evaluated the Soviet threat and outlined the Air Force Space Plan (AW Feb. 26, p. 25), a study of the status of space technology in the Air Force today and its long-range objectives. Aviation Week is publishing significant excerpts from this statement because of their importance to the aerospace industry.]"

USAF WAGES SPACE, WEAPON FUND BATTLES, by Larry Booda, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 76–79.

"Air Force is fighting a funding battle on two fronts—still seeking an expanded and clearly defined space mission, and at the same time, trying to cope with opposition to weapons programs related to its non-space role."

USAF'S 624A TESTS NEW DOD POLICIES, by William H. Gregory, in *Space Technology International*, v. 5, no. 3 (July 1962) 34–36.

"USAF'S 624A Standardized Space Launching System that includes the TITAN 3 booster—the first major Air Force system that will use incentive type contracts from inception —represents an especially high degree of Defense Department involvement in system acquisition and management. DOD's strong interest in the program stems from 624A's trail blazing into management policy areas such as improved cost estimating, reduction of design changes and others that DOD and the military departments are stressing."

E. Missile Sites, Bases, Ranges, and Facilities.

ARCAS TO UPDATE ATLANTIC TRACKING, by Arthur H. Collins, in *Missiles and Rockets*, v. 11, no. 3 (16 July 1962) 22–23.

How new flexibility will be added to the existing Air Force Missile Test Center and Atlantic Missile Range Tracking radars through the newly designed Automatic Radar Chain Acquisition System (ARCAS).

ATLANTIC MISSILE RANGE INSTRUMENTATION, by Charles R. Scott, in *Missiles and Space*, v. 10, no. 6 (June 1962) 26 plus.

A survey of current and projected facilities for data acquisition and processing. With map on the range from Cape Canaveral to Pretoria and beyond.

BUILDING ICBM BASES POSES TOUGH PROBLEMS, in *Armed Forces Chemical Journal*, v. 15, no. 2 (Mar–Apr 1962) 12 plus.

Some of the problems involved due to the inherent characteristics of the missiles.

EDWARDS FLIGHT TEST CENTER OF THE U. S. A. F., by John Ball, Jr. New York, Duell, Sloan and Pearce, 1962. 166 p.

Includes a description of Edwards AFB's contribution to the various space-age projects.

HAYSTACK WILL ADVANCE RADAR PRECISION, by Philip J. Klass, in *Aviation Week and Space Technology*, v. 78, no. 5 (4 Feb 1963) 80–82.

"First elements of Air Force's new HAYSTACK facility, the most advanced installation for space craft tracking, space communications and radar astronomy in the non-Communist world are going into place at Lincoln Laboratory's Millstone Hill facility near Tyngsbor, Mass. Initial calibration tests are scheduled for this summer with full facility operation scheduled for the end of this year. HAYSTACK is expected to have the capability of tracking a target the size of a dime at a distance of 1,000 miles. It will be the first Western radar capable of making contact with more distant planets, such as Mars, Mercury and Jupiter."

ICBM SITE CONSTRUCTION, by T. J. Hayes, III, in *Military Engineer*, v. 54, no. 362 (Nov–Dec 1962) 399–403.

The complex interrelationship of the missile and the facility led to the decision by the Air Force to retain responsibility for facility design. CEBMCO (Corps of Engineers Ballistic Missile Construction Office) assists with design, advertises and awards the construction and procurement contracts for the facilities, and administers them. Part I—FIRST NESTS FOR BIG BIRDS discusses sites for the ATLAS; Part II—SILOS FOR PROTECTION reviews sites for ATLAS F and TITAN I; Part III—IN-SILO SYSTEMS deals with sites for TITAN II and MINUTEMAN.

JPL CENTRALIZING SPACE MISSION FACILITIES, by Barry Miller, in *Aviation Week and Space Technology*, v. 77, no. 22 (26 Nov 1962) 65 plus.

A centralized facility for simultaneously conducting more than one spacecraft mission will go into operation at Pasadena, Calif., early in 1964 as the Jet Propulsion Laboratory prepares for the complex task of handling a heavier, overlapping schedule of planetary and lunar space shots. The new facility, to be known as the Space Flight Operations Facility (SFOF) will be an expanded, updated and consolidated version of the operations center and supporting installations at Pasadena which currently direct and control the nation's unmanned lunar and planetary probes after launch from Cape Canaveral. Management of these space launchers is Jet Propulsion Laboratory's principal assignment under contract from NASA. Expected tasks, present operations, SFOF functions, et cetera.

LAUNCHING THE MOON ROCKET, by Kurt H. Debus, in *Astronautics and Aerospace Engineering*, v. 1, no. 2 (Mar 1962) 20–32.

LC–39 complex of launch facilities for advanced SATURN C–5 marks major advance over past operations with combination of automatic checkout in industrial-like environment, movement of ready vehicles to multipad complex, and remote control of launch itself. Since the problems related to launch operations are LOC's (Launch Operations Center, located at the Atlantic Missile Range) responsibility, the scope of this article is limited to concepts, techniques, and facilities for the launch of the SATURN-APOLLO space vehicle.

MISSILE TEST RANGES (by G. T. Smiley and F. E. Lowther, in *Military Engineer*, v. 54, no. 360 (July–Aug 1962) 274–275.

Industry's role in their development.

MOBILE ATLANTIC MISSILE RANGE STATIONS FOR SHIPBORNE MISSILE-TRACKING STUDIES, by Dr. Lisle L. Wheeler, in *Sperryscope*, v. 15, no. 12 (First Quarter 1962) 6–9.

ON TIME AT WHITE SANDS, by Maj. Gen. John G. Shinkle, in *Ordnance*, v. 46, no. 252 (May–June 1962) 763–766.

How at this missile-testing range a unique innovation to speed missile development is the integration of the contractor research-and-development, engineering-evaluation, and user-testing phases during a system's growth from idea to reality.

PREPARING TO LAUNCH AT POINT MUGU, in *Naval Research Reviews*, v. 16, no. 1 (Jan 1963) 11–16.

A discussion of the Pacific Missile Range (a DOD facility), operated by the Navy, and the U. S. Naval Missile Center. Touches on: the research program at NMC, such as Project HYDRA, using the "water" as a launching pad; weather forecasting; Transit tracking system; et cetera.

II. OTHER FREE NATIONS—MISSILE AND SPACE EFFORTS

A. Multinational Efforts and Cooperation.

THE FIGHTER AIRCRAFT POCKET-BOOK, by Roy Cross. London, Batsford, 1962. 255 p.

Covers the period 1913–1961. Photos and performance characteristics of British, American, German, French, Italian, Japanese, and Soviet aircraft. Includes information on missile carrying fighters. Points out that "the longer-term future of the fighter aircraft is still very much in doubt, due to the advent of the various types of missile, but looking just a little way ahead there are indications that fighter design may yet take some new turnings, ... Vertical takeoff will obviously affect some aspects of fighter design, and while semi-automatic conventional fighters will creep even further up the Mach scale, there may be a place too for large medium-performance aircraft armed with 75–100 mile range air-to-air missiles, opening a new phase of long-range aerial warfare."

NAVAL ANTI-AIRCRAFT MISSILES, in *Interavia*, v. 17, no. 5 (May 1962) 574–575.

Today, the leading naval forces are armed with a wide variety of anti-aircraft missiles: MASURCA, FRANCE; SEACAT 1, SEASLUG, UK; TALOS, TARTAR, TERRIER, and TYPHON, USA. As an example of the most modern types now operational the article discusses the TARTAR. With photos.

PIGGYBACK PAYLOAD DESIGNED, SHIPPED IN ONLY 20 DAYS, by William Beller, in *Missiles and Rockets*, v. 11, no 20 (12 Nov 1962) 22–23.

Goddard Space Flight Center engineers "recently" conceived, instrumented and shipped a 200-lb. payload—in only 20 days—to meet the launch schedule for a scientific satellite. The experiment was sent up Sept. 29 along with the ALOUETTE satellite (S–27)—a joint US and Canadian project. Background, experimental results, design experiment, et cetera.

UK–1 SATELLITE TURNS UP SURPRISES, by Charles D. LaFond, in *Missiles and Rockets*, v. 11, no. 3 (16 July 1962) 26–29 plus.

Preliminary data obtained from the first joint US–UK satellite S–51, the first of at least three joint space ventures between the two countries. Also some details on UK–2 progress.

[U.S. SPACECRAFT AND INTERNATIONAL SPACECRAFT — SPECIFICATIONS], in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 189–190.

Chart showing: category; spacecraft name; agency; prime hardware contractor; max. injected weight; earth orbit altitude; date of first launch; total successful missions; launch vehicle; et cetera.

B. European Cooperation.

THE EUROPEAN APPROACH TO SPACE, in *Interavia*, v. 17, no. 10 (Oct 1962) 1319–1321.

A review of European space research and technology showing "that so far little has been achieved outside the realm of theory, early design work, and administrative preliminaries." The brief review covers: France, German Federal Republic, Italy, The European Joint Organizations, European Space Research Organization (ERRO), European Launcher Development Organization (ELDO), and Eurospace.

THE EUROPEAN LAUNCH VEHICLE, in *Spaceflight*, v. 5, no. 1 (Jan 1963) 8.

Since the signing of the European Launcher Development Organization Convention by the seven countries concerned (Australia, Belgium, France, Federal Republic of Germany, Italy, the Netherlands and the United Kingdom) work has been speeded up on the first program which will lead to the placing into orbit of test satellites in 1966. Herein is a statement relating to progress with the ELDO three-stage launch vehicle, released by the Ministry of Aviation (Gt. Britain on 20 Sept. 1962).

THE EUROPEAN LAUNCHER: PROGRESS AND PROBLEMS, by Dietrich E. Kölle, in *Interavia*, v. 17, no. 10 (Oct 1962) 1322–1324.

The development of a European launch vehicle under the first ELDO (European Launcher Development Organization) program, —which is at present in its critical initial stage. The author describes the first, second, and third stages of the program, as well as ELDO and its technical concept. With photos and sketches.

C. Canada.

CANADA'S FIRST SATELLITE, by H. R. Warren and J. Mar, in *Spaceflight*, v. 4, no. 3 (May 1962) 70–77.

The purpose of this paper is to show some of the problems which exist in the design of modern satellites in the areas of structural and thermal design. Although there is a wide variation in the specific problems which apply from one satellite to another, an attempt is made to show the general type of problem encountered by considering the example of the Canadian Topside Sounder satellite. Discusses: structural design requirements, space materials and components, vibration and acceleration at launch, design of the S–27 satellite, antenna erection units, structural and operational testing, Javelin rocket test, the thermal environment, satellite shape, instrument package design, satellite temperature prediction, and thermal vacuum testing.

D. France.

FRENCH TOUTING MATRA 530, AS–30, in *Missiles and Rockets*, v. 10, no. 17 (23 April 1962) 36.

Several French first-generation missile programs have been phased out, new ones have been committed to production, and several R & D programs will enjoy increased funding support. The newest anti-tank missile, ENTAC, costs only $600 per unit, and its effective 5600 ft.

range "May mean that massive tanks will no longer spearhead blitzkriegs." NORD's AS–12 will be used on anti-armor and surface-target missions of the Navy's Alize and Brequet Atlantic aircraft and by fast escort warships as a defense against torpedo ships. The range of this ship-launched and air-launched missile is 20,000 ft. and 30,000 ft. respectively. Two new air-launched missiles, AS–30 and MATRA "emerged from target tests with honors." Warships up to frigate size will carry the surface-to-air MOSURCA, and the MONITOR is being used as a naval training missile, while the PARCO is used for Army training. Fabrication of these two, however, has been abandoned.

PHAETON—MOST ADVANCED FRENCH DESIGN, by Bernard Poirier, in *Missiles and Rockets*, v. 10, no. 19 (7 May 1962) 41.

"The principal rocket producer in Europe" has revealed the laboratory design of a high-utility satellite which France hopes to orbit within the next few years. Dubbed PHAETON by scientists of La Society d'Etude de la Propulsion par Reaction (SEPR), the 660-lb. self-propelling satellite will produce 2.25 kw electrical power from a 135-sq.-ft. parabolic shield measuring 13.12 ft. across. The limiting component in the French program remains the carrier vehicle.

SPACE RESEARCH FOR SMALLER COUNTRIES — I: THE FRENCH PROGRAMME, by Pierre Auger, in *New Scientist*, v. 16 (20 Dec 1962) 674–676.

How France is collaborating with the US and with the European space research and launcher development organizations.

E. Great Britain.

THE ANTIMISSILE MISSILE, by Maurice Allward, in *Military Review*, v. 42, no. 7 (July 1962) 53–59.

Extracts from an article published in Aeronautics (Gt. Brit.) Jan 1962, under the title, "BRITAIN AND THE ANTI-MISSILE-MISSILE." The author considers some of the major problems of an antimissile system, and then surveys its probable effectiveness under operational conditions.

BRITAIN AND SPACE, by S. W. Greenwood, in *Spaceflight*, v. 4, no. 3 (May 1962) 78–80.

The British Interplanetary Society has been active in urging the Government to join with Western Europe in developing a cooperative program of space development. Other ways of entering the field have been suggested by individuals, and one of them—that of augmenting the US space program—is argued in this article by the author. Before going into the main discussion, the author looks at the environment already established in astronautics by the US and USSR.

BRITISH FINALLY DROP BLUE WATER, by G. V. E. Thompson, in *Missiles and Rockets*, v. 11, no. 8 (20 Aug 1962) 18.

"Cancellation of Britain's BLUE WATER missile has improved chances of the Sperry SERGEANT in the competition for a NATO surface-to-surface tactical nuclear missile." The British weapon was a contender with the US for the short-range NATO role. British projects continued: THUNDERBIRD II—Army's anti-aircraft missile; SEASLUG II—Navy's anti-aircraft missile. New British projects: BLOODHOUND II—surface-to-air guided weapon; SWINGFIRE—wire-guided antitank missile.

BRITISH PROPOSE NEW SEA LAUNCH PAD, by C. V. E. Thompson, in *Missiles and Rockets*, v. 11, no. 2 (9 July 1962) 31.

A radically new type of marine platform ("TRITON") for tracking and launching missiles has been proposed by two British concerns interested in extending the use of moored platforms. It reportedly could be anchored in water exceeding 100 fathoms and would presumably make it more versatile than the "Texas Towers," which are limited to about 30 fathoms for anchorage.

[FIRST EDUCATION ISSUE], in *Spaceflight*, v. 4, no. 6 (Nov 1962) 178–206.

This issue of Spaceflight is devoted almost entirely to the successful Teachers' Symposium which the British Interplanetary Society held at the Northampton College of Advanced Technology, London, and includes the following papers: ASTRONAUTICS IN THE SCHOOL CURRICULUM — SPACE TECHNOLOGY

AND THE FUTURE, by G. A. Tokaty; USES OF A SPACE PROGRAMME, by M. S. Hunt; ASTRONAUTICS IN SCHOOL MATHEMATICS AND PHYSICS, by H. H. Langton; ORBIT DEMONSTRATION MODELS, by J. R. Millburn; PRACTICAL ROCKETRY IN SCHOOL (A description of a unique solid propellant test rig for school use), by P. A. Hilton; PRACTICAL MODEL MAKING; HOW TO USE THE TEACHERS' HANDBOOK OF ASTRONAUTICS, by S. W. Smith, ASTRONAUTICS AND ART, by A. E. Speer; A QUANTITATIVE DOPPLER EFFECT EXPERIMENT FOR THE GRAMMAR SCHOOL SIXTH FORM, by G. E. Perry and D. Slater; ASTRONAUTICS IN SCHOOL CHEMISTRY AND BIOLOGY, by D. H. Howle.

ROCKET PROPULSION TECHNOLOGY. VOLUME I. ed. by D. S. Carton and others. New York, Plenum Press. 1961. 374 p.

This volume contains all the seventeen papers that were read and discussions that took place at the First Rocket Propulsion Symposium, Cranfield, England, January 1961. They deal with controllability of liquid-propellant engines; reliability of solid-propellant motors; reliability of liquid-propellant engines, and other topics.

HOW SEASLUG'S DESIGN WAS EVOLVED, by Bernard Poirier, in *Missiles and Rockets*, v. 10, no. 24 (11 June 1962) 36.

Britain's SEASLUG MK. 1, one of Europe's first operational ship-launched antiaircraft missiles, recently became the first European system to have its design evolution revealed.

UK–1 SATELLITE TURNS UP SURPRISES, by Charles D. LaFond, in *Missiles and Rockets*, v. 11, no. 3 (16 July 1962) 26–29 plus.

Preliminary data obtained from the first joint US–UK satellite S-51, the first of at least three joint space ventures between the two countries. Also some details on UK–2 progress.

F. West Germany.

A GERMAN FOUR-YEAR SPACE PLAN, in *Interavia*, v. 17, no. 10 (Oct 1962) 1259.

A year after its formation, the Deutsche Kommission für Raumfahrttechik (West German Space Technology Committee) made a proposal which is presented in this article. This Committee, representing the West German Aeronautical Sciences Association (DGF), recently submitted to the Federal Minister of Atomic Energy a four-year plan involving an overall budget of DM 933 million, under which research and industry hope to solve jointly the most urgent problems of space technology. The aim of the project is to make it possible for West Germany to cooperate actively in space development and research at the international level. This is an introductory program capacity, and would at the same time train several thousand scientists and technicians.

SIMPLICITY IS KEY TO COBRA MISSILE, by Anthony Vandyk, in *Missiles and Rockets*, v. 11, no. 23 (3 Dec 1962) 28 plus.

Production of more than 30,000 COBRA antitank missiles has established Boelkow Entwicklungen of West Germany as one of Europe's most important manufacturers of guided weapons. Close to 90% of the company's work is for the German Defense Department. To date, only Germany and Denmark have bought COBRA, but orders from Italy and several other European nations are in an advanced stage of negotiation. The US Marines and Army have also evaluated COBRA which is light in weight (31 lbs. including control box), simple, and inexpensive (about $600).

III. U.S.S.R.

A. Miscellaneous Aspects.

THE ANNUAL OF THE LARGE SOVIET ENCYCLOPEDIA—1961. Ezhegodnik Bol'shoi Sovetskoi Entsiklopedii, 1961. Gosudarstvennoe Nauchnoe Izdatel'stvo "Sovetskaia Entsiklopediia," 1961. 519 p. In Russian.

This annual includes information on: Soviet missiles and satellites, and space exploration efforts.

IF SPACE BECOMES A BATTLEFIELD—WILL THE U. S. BE READY? in *U. S. News and World Report*, v. 53, no. 10 (3 Sept 1962) 35–37.

"Space flights by the Soviet Union have suddenly put the spotlight on a new kind of war —armadas of nuclear dreadnaughts . . . . orbiting H-bombs . . . . space interceptors [and manned space bases]. Whole idea of war in

space has moved from the realm of fantasy onto the drawing boards." This article is a report on the problem being considered by the U. S.: where U.S. and Russia stand on the military side of space exploration.

SOVIET SPACE PROGRAMS: ORGANIZATION, PLANS, GOALS, AND INTERNATIONAL IMPLICATIONS. STAFF REPORT PREPARED FOR THE USE OF THE COMMITTEE ON AERONAUTICAL AND SPACE SCIENCES, UNITED STATES SENATE, [BY THE LIBRARY OF CONGRESS], 31 MAY 1962. Washington, Government Printing Office, 1962. 399 p. (87th Congress, 2d Session.)

This study has been divided into three major sections: Part I provides as an introduction a general survey of science in the Soviet Union; Part II deals extensively with Soviet Science in space and Part III concerns certain implications of the space activities of the USSR for international cooperation and international law. Chapters subsumed under these major categories attempt to provide a descriptive account of Soviet science and technology, an estimate of possible Soviet goals in space, an examination of the possible organizational structure of the Soviet space program, a review of some Soviet achievements in space and an analysis of the Soviet attitude toward international cooperation in space and international space law. Among the many appendixes are summaries on Soviet space activities prepared by NASA from United States and Soviet press and radio.

SPACECRAFT AND MISSILES OF THE WORLD, 1962, by James Baar and William E. Howard. New York, Harcourt, 1962. 117 p.

In the preface to the book appears the following note: "As for the material on Soviet missiles, it is considered to be the best available in the West outside of the official intelligence community. Relatively little technical information on Soviet missiles and spacecraft has even been released by the Soviet Union."

B. Astronauts.

GHERMAN TITOV; FIRST MAN TO SPEND A DAY IN SPACE, by Pavel Barashev and Yuri Dokuchayev. New York, Crosscurrents Press, 1962. 111 p.

The "human story of the Soviet cosmonaut who understudied for Yuri Gagarin on man's first flight into outer space and then four months later opened up new vistas in his own historic one-day journey of 17 cosmic sunrises. What lay behind this great achievement? This is Titov's life—his youth, education, pilot training, selection as a cosmonaut, rigorous preparation for space flight—and the . . . . flight itself . . . . Titov the man: his experiences, thoughts, character—how he came to be a cosmonaut."

HOW THE COSMONAUTS WERE TRAINED, by Col. Yevgeni Petrov, in *Missiles and Rockets*, v. 11, no. 8 (20 Aug 1962) 14–15.

Excerpted from Aug. 1962 issue of "USSR" in which the author provides some details on how the Soviet cosmonauts were being trained.

I AM EAGLE! by Gherman Titov and Martin Caidin. Indianapolis, Bobbs-Merrill, 1962. 212 p.

VOSTOK II, Titov, and what happened before and after. Photos. (Based on interviews with Wilfred Burchett and Anthony Purdy.)

MY DAY IN SPACE, by Maj. Gherman Titov, in *Spaceflight*, v. 4, no. 5 (Sept 1962) 146–150.

A slightly abridged version of the speech by Maj. Titov at the Life Sciences session of the 3rd Space Science Symposium organized by the Committee on Space Research (COSPAR) in Wash., D. C. on 3 May 1962, in which were discussed: the basic problems which were to be solved during the flight.

TILL WE REACH THE STARS; THE STORY OF YURI GAGARIN, by Khwaja Ahmad Abbas. New York, Asia Publishing House. 1961. 145 p.

Some family photos.

C. Economic Aspects.

MILITARISM EXHAUSTION OF NATIONS, DEVASTATION OF PEOPLES. Militarizm—istoshchenie natsii, razorenie narodov, by N. Ivanov and R. Faramazian, in Mirovaia Ekonomika i Mezhdunarodnye Otnosheniia, no. 5 (May 1962) 122–130. In Russian.

Soviet "facts and figures" on the extent of military expenditures in the West and other free countries of the world, emphasizing the military expenditures of the United States.

The authors attempt to show "the imperialists are making a major effort to surround socialist countries with a ring of their military bases." Enumerated are types and number of bases. With diagrammatic illustrations and a page-size map showing the locations of rockets, naval, and air bases of the United States, naval and air bases of Great Britain, and naval bases of France.

SPACE RACE STRAINS SOVIET ECONOMY, by Frank G. McGuire, in *Missiles and Rockets*, v. 12, no. 1 (7 Jan 1963) 17–18.

Soviet leaders are facing severe problems in determining which of three possible missile/space courses to follow. Faced with the alternatives—ICBM production, defense against missiles, or space flights—the Soviets reportedly can pursue only one course of action with any degree of vigor, while proportionately downgrading the other two.

D. Lunar Exploration.

THE MOON; A RUSSIAN VIEW, ed. by A. V. Markov. Chicago, University of Chicago Press, 1962. 391 p. In English.

This work was originally published by the State Publishing House of Physical-Mathematical Literature, Moscow, in 1960. The collection of monographs in this book has been written by a group of Soviet scientists and it provides astronomers and other specialists with an all-inclusive and critical presentation of the data on the motion, structure, and physical nature of the Moon which have accumulated to date. The chapters are: I. MOTION, ROTATION AND FIGURE OF THE MOON; II. LUNAR CARTOGRAPHY AND SELENOGRAPHIC COORDINATES; III. DESCRIPTION OF THE LUNAR SURFACE; IV. THE PROBLEM OF THE LUNAR ATMOSPHERE; V. THE PHYSICAL PROPERTIES OF THE LUNAR SURFACE; VI. STUDY OF THE MOON BY MEANS OF RADIO; VII. CHARACTERISTIC FEATURES OF THE RELIEF OF THE MOON; BASIC PROBLEMS OF THE GENESIS AND SEQUENCE OF DEVELOPMENT OF LUNAR FORMATION; VIII. THE ROLE OF EXTERNAL COSMIC FACTORS IN THE EVOLUTION OF THE MOON; IX. THE NATURE OF THE LUNAR SURFACE. Appended: list of details of the Moon's surface; map of lunar relief formation, distinguished according to relative state of preservation and epochal succession of origin; and schematic map of the Moon.

REACHING FOR THE MOON: NASA'S TEN YEAR PROGRAMME, in *Interavia*, v. 17, no. 10 (Oct 1962) 1278–1284 plus.

This report is prefaced by a review of the present Soviet program and their plans to 1967. The report on NASA's long-range program details: plans for the near future with MERCURY, the APOLLO program, SATURN boosters, the whole family of carrier rockets which are the key problem, "VIA MERCURY AND GEMINI TO APOLLO," robots for advancing lunar reconnaissance, Venus and Mars exploration, communications and weather satellites, basic space research, et cetera. With photos, sketches, and charts.

SOVIETS INDICATE LUNAR LANDING SET FOR 1965, in *Missiles and Rockets*, v. 10, no. 25 (18 June 1962) 32.

Russian scientists are recommending a manned lunar landing program which almost duplicates America's Project APOLLO. Some other Soviet plans revealed by the scientists include: scientific exploration of the Moon, further manned flights into space, communications from unmanned lunar spacecraft, lunar maps, and interplanetary manned spaceflight.

E. Missile Diplomacy.

POWER AND POLITICS IN THE SOVIET SPACE EFFORT, by Arnold L. Horelick, in *Air Force*, v. 45, no. 4 (April 1962) 37–38.

Some commentary on the political uses to which the Soviet Union has put its space technological achievements, excerpted from a longer article to be included as a chapter in a forthcoming book, Outer Space and World Politics, ed. by J. M. Goldsen, and published by Praeger, N.Y.

SOVIET GUIDED MISSILE DEPLOYMENT, by Lt. Col. Truman R. Bowman, in *Military Review*, v. 42, no. 11 (Nov 1962) 75–79.

In the years since 1957, "it is more than apparent that the Soviet Union possesses a wide

assortment of guided missiles. The Soviets have fired missiles from Central Asia to the mid-Pacific; they have missiles capable of firing shorter ranges." According to Khrushchev, the Soviets possess guided missiles which can deliver nuclear warheads at short, medium, and long ranges. "To an apprehensive world, the validity of this remark is only too apparent. What is not widely appreciated, though, is Soviet doctrine for the deployment of guided missiles and the organizations or echelons that control their deployment." This the author discusses and illustrates.

SOVIET RUSSIA IN WORLD POLITICS, by Robert D. Warth, New York, Twayne, 1963. 544 p.

Includes a chapter (pp. 451–469) on Soviet entry into the space age and how the military implications of Soviet space achievements are used by Soviet leaders to advance Soviet political aims. (SPUTNIK Diplomacy.)

F. Naval Missiles.

AMERICAN ROCKET-CARRYING ATOMIC SUBMARINES. Amerikanskie atomnye podvodnye lodki-raketonostsy, by Capt. T. Kirillov, in *Mirovaia Ekonomika i Mezhdunarodyne Otnoshennia*, no. 10 (Oct 1962) 123–126. In Russian.

Soviet view of the strategy that prompts the United States to build POLARIS submarines, the effectiveness of the POLARIS missiles, and the extent of the POLARIS program. Tries to show that the POLARIS missile is "inaccurate" as compared to similar Soviet missiles, and that the Red Navy is equipped with "superpowered" nuclear submarines capable of operating at high speeds and great depths and over long periods of time in the most remote areas.

JANE'S FIGHTING SHIPS 1962–1963. New York, McGraw-Hill, 1962. 444 p.

Includes photographs and information of Soviet surface warships equipped with guided missiles, as well as Soviet ballistic missile submarines.

NEW PHOTOS SHOW RUSSIAN NAVAL, SHYSTER MISSILES, in *Aviation Week and Space Technology*, v. 77, no. 22 (26 Nov 1962) 34–35.

The photos and accompanying text show the Russian ballistic missile unveiled at the Nov. 7 Bolshevik anniversary parade. New and older versions of the SHYSTER appeared in the parade. The new version is designated SANDAL.

SOVIET WARSHIPS AS MISSILE PLATFORMS, in *Interavia*, v. 17, no. 11 (Nov 1962) 1460–1461.

Soviet warships armed with guided missiles for use against sea and land targets and with anti-aircraft rockets "have recently been observed both in the Baltic and the English Channel." In practically all cases, the vessels in question are known types which have been provided with new armament to enable them to fulfill additional roles. These modernized vessels are a visible sign of the marked increase of the fighting strength of the Soviet Baltic, Black Sea, and Far Eastern Fleets. With photos and sketches.

G. Policy and Strategy.

CURRENT SOVIET POLICIES: IV. THE DOCUMENTARY RECORD OF THE 22ND CONGRESS OF THE COMMUNIST PARTY OF THE SOVIET UNION, ed. by Charlotte Saikowski and Leo Gruliow. New York, Columbia University Press, 1962. 248 p. (From the translation of THE CURRENT DIGEST OF THE SOVIET PRESS.)

Includes policy pronouncements and statements on missiles and space exploration (e.g. Khrushchev's statements on Gagarin and Titov orbital flights).

MILITARY STRATEGY. Voennaia strategiia, by Marshal V. D. Sokolovskii, Moscow, Voennoe Izdatel'stvo Ministerstva Oborony SSSR, 1962. 456 p. In Russian.

While the book concerns itself with an evaluation of the many areas of Western and US strategy, it also provides much information on present trends in Soviet strategic thinking. Among the subjects covered: strategy and politics; strategy and economics; strategy and military doctrine; the class nature of Soviet military strategy; the strategy of US and NATO; the character of modern warfare; methods of conducting warfare; and means for national defense. The work includes a dis-

cussion of the utilization of cosmic space for military purposes. [English translations of the book are also available on the shelves of the Army Library.]

H. Space Boosters.

HOW BIG ARE THE RUSSIAN BOOSTERS? by William Patterson, Jr., in *Space/Aeronautics*, v. 38, no. 6, part 1 (Nov 1962) 60–64.

More than anything else, greater booster power has given the Russians their impressive head start in the race into space. "But just how powerful are the Red's boosters? They aren't saying, of course, but we can make pretty good estimates." As this article shows, a few, very reasonable assumptions make it possible to interpret what little information we have on the Russian boosters in the light of our own booster progress and come up with good figures for thrust. The basic procedure starts with the known orbital payload of a Soviet shot and arrives at a thrust figure via the payload and thrust weight ratios. The resulting thrust then is adjusted, if necessary, to fit in with the probable development of the Soviet space effort.

PREPARING THE SOVIET SPACE-BOOSTER, in *Spaceflight*, v. 5, no. 2 (Mar 1963) 56–57 plus.

"At the beginning of August, 1962, ... in preparation for the celebration of the anniversary of Titov's flight, the Soviet press began to focus the attention of their readers on spaceflight. A profusion of articles appeared, some of which disclosed hitherto untold details of the earlier flights and of the general organization of the Soviet space effort. For example, 'extracts from the diary' of a test-engineer, L. Maryanin, concerned with preparing the VOSTOK 2 spacecraft and booster, appeared in Pravda on 4–5 August, 1962. The article, which included for the first time particulars of Soviet pre-launch techniques, is presented here in the form of a summary of the most interesting technical items."

I. Space Technology.

RECENT SOVIET ADVANCES IN AEROSPACE TECHNOLOGY, by F. J. Krieger. Santa Monica, California, Rand Corporation, February 1962. 25 p. (Memorandum RM–3053–PR.)

This paper was presented as part of the National Tracking and Command of Aerospace Vehicles Symposium held by the Institute of the Aerospace Sciences in San Francisco, February 19–21, 1962. "The Soviet aerospace program has been developing in three well-defined, although interrelated, phases—the earth-orbital, the lunar, and the interplanetary—with corresponding increase in technological complexity. All phases are aimed at eventual manned interplanetary travel. The current earth-orbital, or man-in-space program, having received the greatest emphasis, has perforce been the most successful. In the interest of economy and expedience, there is a trend in the Soviet Union toward the development of more powerful propulsion systems for launching space vehicles that heretofore were used by combining rocket motors with special purpose turbojet and ramjet engines." Photos and tables. Bibliography.

SOVIET SPACE TECHNOLOGY, by G. A. Tokaty, in *Spaceflight*, v. 5, no. 2 (Mar 1963) 58–64.

This paper depicts "the background of well known and not so well known Soviet achievements and failures in the field of space technology, irrespective of whether it agrees or disagrees with numerous existing books, pamphlets, articles and rumours on the subject." This article is also "a contribution to the history of rocket development in the Soviet Union."

J. VOSTOK Series.

FIRST SOVIET "GROUP" FLIGHT IN ORBIT, in *Spaceflight*, v. 4, no. 6 (Nov 1962) 207–208.

A brief description of the "group" flight carried out with VOSTOKS 3 and 4 in Aug. 1962. An account is included describing some of the preliminary training for this flight.

THE RUSSIAN ADVANCE IN SPACE, in *Interavia*, v. 17, no 10 (Oct 1962) 1260.

A brief review of the launchings and flights of VOSTOK III and VOSTOK IV on 11 Aug. and 12 Aug. 1962.

U.S., SOVIETS DISAGREE ON RENDEZVOUS, in *Space Technology International*, v. 5, no. 4 (Oct 1962) 8–9.

"Significance of the . . . . Soviet manned space flights deepened . . . . when Russia claimed that VOSTOKS 3 and 4 came within 3.1 mi. of each other—a distance that contrasted sharply with the official public stand taken by the U. S. that the two spacecrafts were never closer than 75–100 mi." Also discusses the landing, the launch vehicle and spacecraft, and medical and biological findings.

VOSTOK II'S RE-ENTRY DESIGN—AN EDUCATED SPECULATION, in *Missiles and Rockets*, v. 11, no. 2 (9 July 1962) 18 plus.

The Russians have given the US no technical information about VOSTOK II. "And during Gherman Titov's visit to the US this past spring, it became obvious that they do not intend to." Therefore, US engineers have decided to figure out on their own how the spacecraft worked. This article is an analysis made at a major aerospace concern.

VOSTOKS 3 AND 4 RENDEZVOUS, DOCK IN ORBIT; U. S. RE-EVALUATION SPACE NEEDS, in *Space Technology International*, v. 5, no. 4 (Oct 1962) 4–7.

VOSTOKS, COSMOS BUILD SOVIET SPACE GAINS, by Evert Clark, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 132–136.

"Soviet Russia's 10-to-1 lead over the U.S. in manned space flight experience may be widened even further in 1963 as a result of the highly successful group flight of VOSTOKS 3 and 4 and the intensive Cosmos scientific satellite program. In spite of the great expansion of the U. S. manned program since the first VOSTOK flew two years ago, Russia is in a position to exploit its lead in time and booster power for many months before the U. S. can begin to explore the techniques of rendezvous and multiman flight that are essential to lunar and planetary landings.

K. U.S.S.R. vs. U.S.

1. Miscellaneous Aspects.

AFTER 5 YEARS—WHERE THE SPACE RACE STANDS NOW, in *U. S. News and World Report*, v. 53, no. 14 (1 Oct 1962) 69–80.

"U. S. was left flat on the ground when SPUTNIK I went up in 1957. In the years since then: more Soviet spectaculars—vs. a U. S.—record of solid achievement, largely unnoticed." This 12-page Special Report on space attempts to present "the full story," and reviews: RECORD OF MORE THAN 100 TRIUMPHS IN SPACE [US AND USSR]; WHERE U.S. SETS THE RACE—A SKY FULL OF SATELLITES AND MORE TO COME; MIGHTY SATURN ROCKETS—AMERICA'S HOPE IN MOON RACE, by Wernher von Braun; IN NEXT FIVE YEARS—FIRST MEN ON THE MOON—THE U.S. AND SOVIET TIMETABLES; THE NEXT 25 YEARS—COLONIES ON THE MOON—AND FIRST MEN ON MARS; WHERE THE SPACE BILLIONS WILL GO [STATES SHARING IN THE SPACE BOOM].

BEYOND THE MOON, by J. S. Butz, Jr., in *Air Force*, v. 46, no 2 (Feb 1963) 30–34.

"There is little doubt that in the long run a properly planned, financed, and understood American program would swamp the Soviets in Space—even if they do make an APOLLO-type landing on the Moon before we do. What counts is strength and staying power. But current plans and appropriations won't put much staying power behind our APOLLO. And our space program in the 1970's is going to suffer accordingly. We must plan . . . . beyond the Moon."

THE SPACE RACE: FROM SPUTNIK TO APOLLO AND BEYOND, by Donald W. Cox. Philadelphia, Chilton, 1962, 393 p. (Foreword by the Honorable J. W. Fulbright, Chairman of the U. S. Senate Committee on Foreign Relations.)

". . . . Covers the major cosmic-shaking events of the critical past half-decade with a survey of the reasons why the United States continues to lag behind the Soviets in achieving notable firsts in space." The book contains many references on US Army, Navy, and Air Force programs. In seeking a way to thwart the Communist dreams of control of the cosmos, the author offers a long-range 40-year grand assault on space, cooperating with the Soviets through the United Nations. Appended: a graph showing USSR-US space race 4 October 1957—January 1963; also Space Race Time-

table for the Cosmic Sixties (US-USSR) 1962 to 1969.

USAF STUDIES U. S. SOVIET SPACE POTENTIAL, in *Aviation Week*, v. 76, no. 10 (5 Mar 1962) 75 plus.

"[Air Force Lt. Gen. James Ferguson, deputy chief of staff for research and technology, told the House Armed Services Committee recently that it will take a concerted national effort to create a military posture adequate to counter the potential threat of the Soviet Union's military activity in space. In a public statement released after the closed hearing, Gen. Ferguson evaluated the Soviet threat and outlined the Air Force Space Plan (AW Feb. 26, p. 25), a study of the status of space technology in the Air Force today and its long-range objectives. Aviation Week is publishing significant excerpts from this statement because of their importance to the aerospace industry.]"

VICTORY IN SPACE, by Otto O. Binder. New York, Walker, 1962. 211 p.

"This book's purpose . . . . is to offer a clarifying 'breakdown' of the over-all space competition between the USA and the USSR, subdividing it into its various technological phases. Through this piecemeal analysis, perhaps we can more properly evaluate just what the true 'score' is today, and what America's future hopes are for 'catching up.' " The author believes that in its space race with the Soviet Union, the United States can win out in the long run "but not just with mountains of money, armies of scientists, or a thundering avalanche of ingenious spacecraft." He believes that the victory will come "with the intangibles of our human spirit: superb space leadership, a strong sense of national urgency, and above all the whole-hearted support of 185 million American hearts and purses."

2. *Soviet Missile Gap.*

MILITARY RECORD OF CBR/ATOMIC HAPPENINGS. 1962 THEME: EAST-WEST AIR ATOMIC ORDER OF BATTLE. London, Aviation Studies Limited, 1962. 23 p. (Reports WS.045.)

Current Order of Battle gives estimates of missile strengths of US and USSR.

MISSILE RACE—NOW U.S. LEAD WILL WIDEN, in *U.S. News and World Report*, v. 52, no. 19 (7 May 1962) 42–44.

"Nuclear tests over the Pacific point this up: It is the US, not Russia, that holds the real missile power in the world. Mighty missiles, armed and ready, now are in firing position on land and sea. And these are only the beginning." Includes data on: where 1,000 long-range missiles in the U.S. will be ready to fire if needed.

WHATEVER HAPPENED TO THE "MISSIBLE GAP"? in *U. S. News and World Report*, v. 52, no. 16 (16 Apr 1962) 82–83.

"The mystery of the big 'missile gap' that worried many Americans for years finally has been cleared up. Now it turns out that the gap was a myth—an estimate based on missile-making 'capabilities' the Russians didn't use." This report presents "the whole picture of a missile alarm that spread, then receded, then vanished, on refiguring."

WHERE THE SPACE RACE STANDS NOW, in *U.S. News and World Report*, v. 53, no. 9 (27 Aug 1962) 31–34.

"This is the official appraisal—Soviet spacemen, whirling around Earth in pairs, do little to shift the lead in space race, or the race for the Moon. Russian feat is due to big Soviet rockets, but they're no bigger now than they were. US calls the Soviet lead temporary. Officials, measuring all space achievements to date, and still confident an American will be first to land on the Moon and return."

WHY IT'S RUSSIA'S TURN TO WORRY ABOUT A "MISSILE GAP," in *U.S. News and World Report*, v. 53, no. 23 (3 Dec 1962) 45–58.

"Almost unnoticed, U.S. has moved into a position of overwhelming superiority in long-range missiles. ATLAS ICBM's are now deployed, ready for action. TITANS are going into place at a rapid clip. More POLARIS submarines are at sea. MINUTEMAN is ahead of schedule. For the first time, missiles in sheer numbers are tipping the balance of power in the world—a force to be reckoned with. All this is bad news for Khrushchev. It's a field where Russia despite boasting, hasn't kept pace. And Reds will drop further behind in months to come." Latest numerical estimates are included.

IV. TRENDS AND DEVELOPMENTS IN MISSILES, ROCKETS, AND SPACE VEHICLES

A. Miscellaneous Aspects.

ADVANCES IN SPACE SCIENCE AND TECHNOLOGY, ed. by Frederick I. Ordway, III. v. 4. New York, Academic Press, 1962. 431 p.

The six chapters in this book examine many vital areas of basic and applied astronautics. The first chapter deals with one of the more practical aspects of artificial satellites, measurement of the Doppler effect. The second chapter deals with the possibility of the existence of intelligent beings other than man; the third chapter,—the development of multiple staging in military and space carrier vehicles; the fourth chapter,—spacecraft entry and landing in planetary atmospheres; the fifth chapter,—development of manned artificial satellites and space stations; and the last chapter,—on the utilization of radioactive elements as energy sources for spacecraft propulsion.

AEROSPACE TECHNICAL FORECAST 1962–1972. Washington, Aerospace Industries Association of America, 1962. 144 p.

This is the eighth AIA report forecasting technical trends and requirements in which emphasis is placed on engineering interpretation of future trends in operating environments and systems design, which will create new requirements in the fields of materials, components, subsystems, design manufacturing and testing. The various sections of the report deal specifically with: environmental trends; system trends; propulsion trends and requirements; materials requirements; system components requirements; ground support equipment trends and requirements; manufacturing process trends and requirements; and testing trends and requirements.

THE ATMOSPHERIC SCIENCES, 1961–1971. Washington, National Academy of Sciences-National Research Council, 1962. 3 v. (Publication 946.)

A report to the Special Assistant to the President for Science and Technology by the Committee on Atmospheric Sciences, National Academy of Sciences-National Research Council. This is a study of ten-year goals "which will enable us to develop a forward-looking national program in the atmospheric sciences." The first volume deals with GOALS AND PLANS (Past and Present Trends; the Manpower Situation; Aeronomy and Planetary Atmospheres; Composition, Heat Balance, and Related Fields; Propagation Phenomena and Indirect Probes in the Lower Atmosphere; Cloud Physics and Weather Modification; Motions and Weather Systems; Biometeorology; Engineering Application; New Technologies; Equipment Development; Major Facilities and Networks; and International Cooperation). Volume two contains Summaries of Planning Conferences of the Committee on Atmospheric Sciences. Volume three deals with GOALS AND PLANS FOR AERONOMY.

INFRARED IN SPACE, by Bernard Kovit, in *Space/Aeronautics*, v. 39, no. 1 (Jan 1963) 56–67.

A survey of infrared systems and subsystems as used in space flight. Reviews current and projected applications, gives data on the size of the market, analyzes the outstanding developmental problems, and discusses the most promising new design approaches.

[INTEGRATING SPACECRAFT ELECTRONICS], in *Astronautics*, v. 7, no. 5 (May 1962) 24–41 plus.

A good portion of this issue of Astronautics is devoted to Integrating Spacecraft Electronics, featuring the following articles: THE ORBITING GEOPHYSICAL OBSERVATORY—NEW TOOL FOR SPACE RESEARCH, by George H. Ludwig and Wilfred E. Scull (OGO design and instrument integration philosophy allows the scientist to conduct his experiments in a classical manner.); WHAT IS A SPACECRAFT ELECTRONIC SYSTEM? by Eberhardt Rechtin (Sufficiently real to survive cliches, it sees the impress of some of the most precise, advanced theory and engineering in the world today.); INTEGRATING ISOTOPIC POWER SYSTEMS, by Capt. R. T. Carpenter and Douglas G. Harvey (The same properties that give them value for certain space missions also create interface problems—electrical, thermal and radiative.); INTEGRATING MERCURY ELECTRONIC SUBSYSTEMS, by Charles V. Wolfers (Developing the MER-

CURY spacecraft provided valuable lessons in integration of electronics for advanced manned vehicles.); SYSTEMS APPROACH TO FLIGHT CONTROLS, by Will L. Holladay and Dale P. Hoffman (Systems analysis coupling theory, simulator work, and flight testing defines the performance guiding electronic control development.); CONSTRAINTS IN SPACE TELECOMMUNICATION SYSTEMS, by Richard P. Mathison (They drive the engineer to explore subtleties in the range equation and to balance a host of seemingly more mundane problems—shape, size, the environment, ground stations, schedules, economics, et cetera.).

MISSILES AND THE REVOLUTION IN WARFARE, by Nels A. Parson, Jr. Cambridge, Harvard University Press, 1962. 245 p.

"Whenever missiles are discussed, the questions still urgently asked are, 'Will guided missiles bring push-button warfare? Do they make other weapons obsolete? What defense is there against them?'" The purpose of this book is to answer these questions about missiles by surveying their developmental history, describing their technical characteristics, and analyzing their revolutionary impact on military operations. This book is an outgrowth of an earlier volume, GUIDED MISSILES IN PEACE AND WAR, published originally in 1956. Appendices: The 25-Year Missile Revolution (1935–1960), and Glossary of Commonly Used Guided Missile Terms.

A REVIEW OF SPACE RESEARCH. Washington, National Academy of Sciences, National Research Council, 1962. Various paging. (Publication 1079.)

The report of the Summer Study conducted under the auspices of the Space Science Board of the National Academy of Sciences at the State University of Iowa, Iowa City, Iowa, June 17–August 10, 1962. The study was undertaken in response to request and supported by a grant from the National Aeronautics and Space Administration (NASA), to examine the current national program of basic research in space and its future objectives. The contents deal with astronomy, celestial mechanics, lunar astronomy, particles and field, meteorological rockets and satellites, biology, space probe sterilization, the scientific role of man in space exploration, NASA/university relationships, block allocation of payload space, scientific uses of spacecraft launched by other Federal agencies, international cooperative programs, some special implications of the space program, and briefings of the NASA space science program.

ROCKETS AND SPACE FLIGHT, by Hans K. Kaiser. New York, Pitman, 1962. 154 p.

This book endeavors to explain what has been achieved so far, as well as the awe-inspiring possibilities which spaceflight will open up for mankind. Diagrams and, illustrations amplify the text. Among the chapters: rockets and artificial satellites; some problems of space medicine; who owns space?; the future of spaceflight; and the cost and value of spaceflight.

SOME ASPECTS OF RECENT PROGRESS IN ASTRONAUTICS, in *British Interplanetary Society, Journal*, v. 18, no. 8 (Mar–Apr 1962) 295–305.

Astronautics demands the services of almost all branches of science and engineering and also requires the assistance of other fields of knowledge. However, despite the need for a wide variety of disciplines, "the factor which has played the greatest part in raising astronautics from a paper study to a practical proposition has been the development of launching vehicles of greater and greater size and higher and higher performance." Thus a significant part of this paper is devoted to launching vehicles and their propulsion systems. Chemical rockets (liquid hydrogen, structural efficiency, specific solid propellant motors, boost recovery, free radicals, and orbital rendezvous), atomic propulsion, electrical propulsion, and the next few years in space.

SPACE FLIGHT AND SPACE-MECHANICAL PROBLEMS, by Paul R. Nielsen, in *Missiles and Space*, v. 11, no. 1 (Jan 1963) 10–11.

Perhaps one of the most important of all mechanical problems to be encountered in space is that of contact interaction between surfaces which must be exposed to the cleaning action of space, where natural atmospheric protection will be lost. Some traditional mechanical fundamentals must be reconsidered, or space mechanisms may fail when most needed. This article also points out some of the hazards satellites will face in space.

SPACE SCIENCE, RESEARCH EFFORT GROWS BUT FAILURES BESET LUNAR MISSIONS, by Alfred Alibrando, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 124–125 plus.

"Space science and research under way by the National Aeronautics and Space Administration is growing to the point where the $1.2 billion requested in this category for Fiscal 1964 is more than the $964 million NASA spent for all its programs in Fiscal 1961—including the MERCURY manned flight program. Bulk of U.S. spending for space science and research is done by NASA, whose comprehensive flight program ranges from use of small sounding rockets for studies of the near-Earth environment to heavy and complicated spacecraft for missions to the Moon and the planets."

[SPECIAL REPORT ON SPACE ELECTRONICS], in *Missiles and Rockets*, v. 11, no. 12 (17 Sept 1962) 22–68.

Almost the entire issue is devoted to the special report dealing with the following: MARKET OUTLOOK ($22-Billion Market Through 1970); PROCUREMENT (NASA, DOD Want More Contractors); TRACKING AND CONTROL (More Launches Will Tax Techniques); TELEMETRY (Data Bottleneck Doomed by Changes); COMMUNICATIONS (No Breakthroughs for Next 5 to 7 Years); GUIDANCE (Radio-Inertial Guidance Systems Preferred); SPACE POWER ($125 Million in NASA Power Program); CHECKOUT SYSTEMS (Demand for Repair Capability Growing); SCIENTIFIC INSTRUMENTATION (Costs Will Soon Exceed Those of Launch Vehicles); ENVIRONMENTAL EFFECTS (Reliable Radiation Test Data Needed).

[STATE-OF-THE-ART REPORTS], in *Astronautics*, v. 7, no. 11 (Nov 1962) 48–55 plus.

The following collection of articles are a series of state-of-the-art reports on missile and space technology and related subjects: GUIDANCE AND CONTROL, by Donald P. Legalley; ASTRODYNAMICS, by Victor G. Szebehely; ELECTRIC PROPULSION, by Ernst Stuhlinger; PHYSICS OF THE ATMOSPHERE AND SPACE, by Francis S. Johnson; TEST, OPERATIONS, AND SUPPORT, by Bernhardt L. Dorman and Lt. Col. Prentice B. Peabody; SOLID-PROPELLANT ROCKETS, by Thomas E. Myers; NUCLEAR PROPULSION, by Frank E. Rom and Harold B. Finger; COMMUNICATIONS AND INSTRUMENTATION, by Albert R. Crocker; PROPELLANTS AND COMBUSTION, by Stanford S. Penner; BIOASTRONAUTICS, by Eugene B. Konecci; POWER SYSTEMS, by Nathan W. Snyder; SPACE LAW AND SOCIOLOGY, by Andrew G. Haley; UNDERWATER PROPULSION, by Leonard Greiner; STRUCTURES AND MATERIALS, by Edwin G. Czarnecki; RAMJETS, by Gordon L. Dugger; and MAGNETO HYDRODYNAMICS, by Edwin L. Resler, Jr.

B. Boosters.

THE AIR-BREATHING BOOSTER, in *Spaceflight*, v. 4, no. 5 (Sept 1962) 142–144.

This type of booster is discussed in light of the fact that satellites of 50 tons mass and a a fourfold increase in orbital payloads are possibilities if advanced forms of air-breathing engines should be developed to take place of the giant rocket now used for satellite launching. The cost of this system could be much lower, too, especially if the launching vehicle were designed to be recoverable for repeated use.

AIR-BREATHING BOOSTERS GAIN FAVOR, by William Beller, in *Missiles and Rockets*, v. 12, no. 11 (18 Mar 1963) 22–23 plus.

NASA "sees prospect of cutting vehicle costs, adding payload." In-house NASA studies reveal Hypersonic Research Vehicle (HRV) shows that using air-breathing booster as a first stage, followed by a rocket second-stage "has a lot of merit." The NASA-USAF program for an Aerospace Plane (ASP) envisions using an air-breathing booster. How an air-breathing vehicle could launch a 50-ton satellite.

BIG SOLID BOOSTERS, in *Aerospace Management*, v. 5, no. 9 (Sept 1962) 48–52.

A staff report on "the challenge and the progress." The report maintains that "big solid boosters will be built. It is now a question of time, mission and cost. NASA wants a 'demonstration program' on 156 in. and 260 in. diameter motors." Use of clustered solids for first stage of SATURN, NOVA and "past lunar" programs is being studied in detail by NASA and DOD.

BOOSTER RECOVERY BY PARAGLIDER, by Octave Romaine, in *Space/Aeronautics*, v. 37, no. 5 (May 1962) 78–81.

Among the variety of booster recovery systems that have been proposed at one time or another, the paraglider, or Rogallo wing, appears to have a number of solid advantages over the others. This article outlines the basic conditions that must be met in the recovery of current and future large boosters, and compares paragliders and other systems in the light of these requirements. It also reviews a computer study in which the recovery by paraglider or a SATURN-type booster was analyzed in detail, and discusses advanced paraglider design features that are now being developed.

KEEP TO "ECONOMICAL" SPACE FLIGHT: SATURN HARDWARE AND REUSABLE BOOSTERS, by J. T. Gordon and W. H. Siegried, in *Space/Aeronautics*, v. 93, no. 3 (Mar 1963) 93–95.

The cost of space flight can be brought down sharply if we make full use of the hardware we are planning and if we develop reusable boosters. To bolster their case, the authors review the growth potential of the SATURN, which could be used for boosters to succeed the ATLAS-CENTAUR, for simple and complex space stations to be used for test flights in preparation for manned planetary flight, and for planetary missions themselves. In their analysis of re-usability they examine the possibility of recovery by inflatable drag cones and point up the advantages of nuclear boosters.

[LARGE LAUNCH VEHICLES], in *Astronautics*, v. 8, no. 1 (Jan 1963) 26–32 plus.

This report on large launch vehicles is composed of the following six papers: NON-RECOVERABLE BOOSTERS, by Richard B. Canright and Norman Rafel (The US stable of rocket vehicles now seeing development and use will run well into the 1970's, and departures from this main course of investment should not be expected early.) ; STRUCTURES AND MATERIALS IMPASSE? by William A. Mrazek (More than ever before, the designer finds himself "boxed in" by formidable walls—hard limits set up as Manrating, Reliability, Performance, State of Technology, Schedule, and Cost.) ; COST-OPTIMIZING MULTISTAGE ROCKETS, by Paul R. Hill (Selection of a booster system and its optimum rocket sizes should be based on the economics of achieving the mission.) ; THOUSAND TONS TO ORBIT, by Robert C. Truax (A 20,000-ton recoverable sea-launch rocket may allow the cheap payload-delivery costs required to make extensive manned lunar and planetary programs practical.) ; REUSABLE LAUNCH SYSTEMS, by Leonard M. Tinnan (Whatever the budget limits, development of a winged, recoverable rocket-powered launch system capable of orbiting Saturn-class payloads looks practical now, from available technology.) ; EVOLVING SOLID BOOSTERS FOR SPACE MISSIONS, by William Cohen (System studies have established big solids as real contenders for space vehicles capable of delivering 250–500 tons to orbit.).

LARGE REUSABLE BOOSTER DESIGNS STUDIES, by C. M. Plattner, in *Aviation Week and Space Technology*, v. 78, no. 5 (4 Feb 1963) 52–53 plus.

High costs of post-APOLLO lunar and interplanetary missions will require that large, recoverable boosters developed for these missions be reused up to ten times, according to a feasibility study for NASA. Preliminary conclusions of the study were presented at the ninth annual American Astronautical Society meeting in Los Angeles. The meeting was informed that recoverable vehicle operational costs would be 50% less than non-recoverable vehicle costs.

C. Design, Testing, and Evaluation.

AIR PROVING GROUND EMPHASIS SHIFTS TO SPACE OPERATIONS, in *Missiles and Rockets*, v. 11, no. 11 (10 Sept 1962) 36–38 plus.

How new emphasis on space operations and electronic testing today is overshadowing more conventional aircraft and missile test programs at Air Force System Command's Air Proving Ground. The Center is deeply involved in testing HOUND DOG, BULLPUP, QUAIL, and the other missile systems. "But it already has proved its new space capability with unique contributions to Project MERCURY and by an extensive space probe program.

AUTOMATIC TEST AND CHECKOUT IN MISSILE AND SPACE SYSTEMS, by Larry T. Mast, in *Astronautics and Aerospace Engineering*, v. 1, no. 2 (Mar 1963) 41–44.

A discussion on whether it is wise to introduce various automatic testing and checkout equipment throughout a major missile or space-vehicle development program. How this step requires careful weighing of cost, and technical and human factors.

COMPUTERS IN MANNED SPACE FLIGHT, by James H. Turnock, Jr., in *Sperryscope*, v. 16, no. 3 (Fourth Quarter 1962) 6–9.

Discusses some of the many activities connected with a manned lunar mission in which computers play a leading role, such as design, mission planning, checkout, operations, et cetera.

DESIGN CRITERIA FOR MISSILES, by L. G. Evans. Paris, North Atlantic Treaty Organization, Advisory Group For Aeronautical Research and Development, April 1962. Various paging. (Report 338.)

This report is one in the series 334–374, inclusive, presenting papers, with discussions, given at the AGARD Specialists' Meeting on "Stability and Control", Training Center for Experimental Aerodynamics, Rhode-Saint-Genèse, Belgium, 10–14 April, 1961, sponsored jointly by the AGARD Fluid Dynamics and Flight Mechanics Panels. The requirements of missile control system design are compared with those of manned aircraft, showing where advantage can be taken of the absence of aircrew or passengers. The basic problems which beset the missile designer are reviewed.

DESIGN GUIDE TO ORBITAL FLIGHT, by Jorgen Jensen and others. New York, McGraw-Hill, 1962. 896 p.

This design guide to orbital flight was prepared by the Aerospace Division of Martin Marietta Corporation as a tool for analysis of basic orbital problems. Much of the information in this book is developed from earlier studies supported by the Navigation and Guidance Laboratory of the Wright Air Development Division (USAF). Wernher von Braun in the foreword to the book states in part: "Here, for the first time, a ready reference on satellite flight mechanics is available for vehicle design engineers. In this volume, the emphasis has been on material needed for earth-orbital operations, since this is the first step that man will have to master before he can leap to the Moon and the planets and since men and supplies will probably be transported by 'space trucks' and 'space buses' into orbit around the earth before assembling into space stations and lunar or interplanetary vehicles." With chapters on: orbit mechanics, physical data, orbit perturbations, satellite lifetimes, ascent to orbit, maneuvers, satellite rendezvous, satellite recovery, satellite re-entry, satellite orbit computation, guidance and control requirements, and mission requirements. With graphs, monograms, and tables.

DESIGN OF A SPACE ENVIRONMENTAL FACILITY, by Robert Klein, in *Missiles and Space*, v. 10, no. 6 (June 1962) 28–29 plus.

With more and more emphasis being placed on satellite and "man in space" programs, the search for knowledge of the effects of space environment becomes more concentrated. How, to insure high reliability, the payload equipment must be thoroughly tested in a simulated space environment.

NEW MISSILE CONCEPTS STRESS ENVIRONMENT, by Irving Stone, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 141–143 plus.

"Planning, development, deployment and updating of US ballistic missiles has reached a new plateau of technological effort that ranges from formulation of future strategic concepts to refinements for greater effectiveness of missiles systems on alert status. Much future design of missiles will depend on the environment that will be most desirable for increasing the potential of advanced systems."

PIGGYBACK PAYLOAD DESIGNED, SHIPPED IN ONLY 20 DAYS, by William Beller, in *Missiles and Rockets*, v. 11, no. 20 (12 Nov 1962) 22–23.

Goddard Space Flight Center engineers "recently" conceived, instrumented and shipped a 200-lb. payload—in only 20 days—to meet the launch schedule for a scientific satellite. The experiment was sent up Sept. 29 along with the ALOUETTE satellite (S–27)—a joint US and Canadian project. Background, experimental results, design experiment, et cetera.

SHORT-RANGE GUIDED WEAPONS, by J. Clemow. London, Temple, 1961. 79 p.

This monograph is a general introduction to the technical problems associated with the design of short-range guided (tactical) weapons. The advantages of guided weapons; main parts of a guided missile; aerodynamic and propulsion considerations; methods of guidance; control system; hypothetical design problem. Select bibliography.

STRUCTURAL DESIGN OF MISSILES AND SPACECRAFT, by Lewis H. Abraham. New York, McGraw-Hill, 1962. 335 p.

Flight loads, environment, gas properties, aerodynamic and solar heating, heat transfer through the structure, thermal stresses, and materials and material behaviors, pressure containing structure, pressure stabilized structure, aeroelastic effects and dynamic loads, structural fatigue, heat protection systems, reliability. Appended: atmospheric data, temperature versus Mach number, design charts for thermal gradients, design charts for thermal stresses, and physical properties of materials.

D. Ground Support Equipment and Ground Support Systems.

AEROSPACE GROUND EQUIPMENT, by B. F. Rose, Jr., in *Military Engineer*, v. 54, no. 361 (Sept–Oct 1962) 319–321.

Launch facilities are literally the foundation for the success of any space vehicle program. The completion of these facilities is often the critical pacing factor in getting a particular missile or space system operational. Looking ahead perhaps three to five years, facilities design appears to favor assembly-line techniques and other schemes to utilize the expensive and highly complex installations more efficiently. The location of launch facilities adjacent to navigable waterways will be necessary for operational flexibility and economy. Also the possibility of providing offshore platforms for launch facilities is being studied. Other ideas for specialized handling equipment for transferring, maneuvering, and assembling large, heavy space vehicle components is touched on. Studies on several possible techniques for meeting these demands are under way: PROP (planetary rocket ocean platform); HYDRA (R & D on Launchings of a liquid-propellant rocket vehicle floating in an upright position in the sea.)

BIG ROCKETS, by Milton W. Rosen, in *International Science and Technology*, no. 12 (Dec 1962) 66–71 plus.

"Man's exploration of space begins with the story of the great engines that will propel him to the Moon and planets . . . . engines of unprecedented power and reliability." The author discusses the engineering difficulties involved in developing the rockets that will go to the Moon.

THE ELECTRONIC GSE MARKET, in *Space/Aeronautics*, v. 38, no. 7 (Dec 1962) 68–69.

Reviews factors involved in aerospace spending for ground support equipment and discusses the future of the GSE market. Includes tables that give medium-range estimates of GSE spending, based on an extensive survey of companies and individuals engaged in GSE work.

GROUND SUPPORT SYSTEMS FOR MISSILES AND SPACE VEHICLES, ed. by Kenneth Brown and Peter Weiser. New York, McGraw-Hill, 1961. 490 p.

"A course, Ground Support Systems for Missile and Space Vehicles, was offered at the University of California, Los Angeles, in 1960 under the auspices of the Engineering and Physical Science Extension Department The course enjoyed such popularity that it was felt the information should be documented in book form." The editors state that the aim of this book is to present a complete picture of the systems required to support either a missile or a space vehicle, and that it will provide the working engineers with an understanding of the many diversified subjects and subsystems that comprise a ground support system. The book is divided into five parts. The first four chapters cover the management concepts which include operational design, operational procedures, support system data, and the personnel subsystem. The second part, titled "Launch Control and Automatic Checkout," covers the field from the design, operation, and application standpoint and includes a comprehensive review of data acquisition and ground guidance systems. Part III deals primarily with the design and develop-

ment of facilities which include both soft and hard-base launchers. Liquid propellant handling considerations are covered in Part IV and include a detailed discussion of cryogenics, hazards and safety, and the design and development of fast-fill propellant loading systems. Part V, has five chapters dealing with the more technical and peripheral aspects of ground support systems. Here, weapons effects, survivability, mobility, reliability, logistics, and maintenance are fully covered. Illustrations.

MOBILE SUPPORT SYSTEMS, by Keith G. Powers, in *Missiles and Space*, v. 10, no. 6 (June 1962) 20–21 plus.

How, with the transition of the missile era from a period of testing and experiment to one of full-scale production for installation at widely dispersed ICBM arsenals, the role of missile support equipment has changed from a stationary to a mobile concept?

WHAT WILL WE NEED BY 1972, in *Ground Support Equipment*, v. 4, no. 6 (Dec 1962/Jan 1963) 16–18.

A review of the broad trends in ground support equipment research and engineering required during the next ten years to meet the anticipated needs in our national aerospace programs: tactical and strategic missile systems; space vehicle systems; ground electronics for missile and space system launch; and general support systems.

E. Guidance, Control, and Navigation

ATTITUDE CONTROL FOR UNMANNED SPACECRAFT, by James Holahan, in *Space/Aeronautics*, v. 39, no. 2 (Feb 1963) 78–86.

Sensors and activators of greater accuracy and reliability are the prime requirements to attitude control for the upcoming second-generation spacecraft and their successors. After reviewing the present state of stabilization systems, the report surveys the outlook for improvements in sensor and actuator performance. In particular, the possibilities of natural energy sources like gravity gradients and magnetic fields are explored, and the characteristics of advanced actuators—including novel gyro stabilizers, liquid flywheels, reaction jets, and ion engines—are analyzed.

COMMAND AND CONTROL OF SPACE SYSTEMS, by Wolf Haberman, in *Missiles and Space*, v. 10, no. 8 (Aug 1962) 12–15.

This article indicates how five basic elements which constitute the modern system are combined into a modern command and control system.

CRITICAL BIO-ENGINEERING NEEDS FOR LUNAR MISSIONS, by Lt. Col. J. J. Rose, in *Aerospace Engineering*, v. 21, no. 4 (Apr 1962) 50–51 plus.

An outline of the bio-instrumentation and bio-technology requirements for lunar missions, with particular attention to the need of, requirements for, and advantages of a multipurpose space-flight control center and command control and guidance system.

GUIDANCE AND CONTROL, ed. by Robert E. Robertson and James S. Farrior. New York, Academic Press, 1962. 670 p. (Progress in Astronautics and Rocketry—Volume 8.)

A selection of technical papers based mainly on a symposium of the American Rocket Society held at Stanford University, Stanford, California August 7–9, 1961. With chapters on: ascent, space operations; descent; inertial navigation; inertial components; optical navigation; adaptive systems; attitude control. Illustrations.

INERTIAL GUIDANCE, by B. Lichtenstein, in *Ordnance*, v. 47, no. 255 (Nov–Dec 1962) 363–366.

Our modern intercontinental weapons require highly complicated devices to control their flight. The author explains the vital roles of the gyroscope and the electronic computer in this sophisticated system.

MMRBM GUIDANCE TECHNIQUES DESCRIBED, by Philip J. Klass, in *Aviation Week and Space Technology*, v. 77, no. 21 (19 Nov 1962) 83–84 plus.

Report of techniques which may be used for mobile medium-range ballistic missile guidance and to determine the position of its transporter-erector vehicle at launch—as described "recently" by a group of engineers who are involved in the program definition phase on the Air Force MMRBM.

NAVIGATION SYSTEMS FOR AIRCRAFT AND SPACE VEHICLES, ed. by T. G. Thorne. Oxford, Pergamon Press, 1962. 550 p.

Papers presented at the AGARD (Advisory Group for Aeronautical Research and Development, North Atlantic Treaty Organization) Avionics Panel Meeting 3–8 October 1960, Istanbul. Part C—pp. 445 to 537 deals with navigation in space and navigation on earth using satellites. Photos and other illustrations.

NEW OPPORTUNITIES FOR INSTRUMENTATION IN SPACE EXPLORATION, by Hugh L. Dryden, in *Signal*, v. 17, no. 6 (Feb 1963) 28–30 plus.

Advances in instrumentation have progressed in recent years along three lines: the continued development of new sensors to meet new needs; the development of instrumentation systems which combine many instruments, computers, and display devices to give the desired technical information in integrated form, often combined with automatic control devices; and the development of still more complex supersystems to answer questions needed to manage very large technical enterprises, often of a global nature. The exploration of space has added new impetus to these developments which had their origin in industrial and military needs, and presented many new opportunities for challenging developments in instruments, instrumentation systems, and automatic controls.

SPACE NAVIGATION, by Capt. R. V. H. Weems, in *US Naval Institute Proceeding*, v. 88, no. 11 (Nov 1962) 84–92.

The navigation of a space craft to the Moon will be, in many respects, simpler than sea or air navigation on Earth, this author predicts. He proposes using a system based on known physical laws and accurate star positions determined by astronomers.

SPACE NAVIGATION BY SELF-CONTAINED MEANS, by W. J. Reilly and K. N. Satyendra, in *Navigation*, v. 9, no. 3 (Autumn 1962) 211–219.

This paper describes methods useful in the navigation of space vehicles. The methods considered lend themselves to implementation onboard the space vehicles. Reviews the open and closed loop methods, advanced optical techniques, et cetera.

A SURVEY OF GUIDANCE AND NAVIGATION PROBLEMS FOR THE MANNED LUNAR MISSION, by John S. White and Rodney C. Wingrave, in *Navigation*, v. 9, no. 2 (Summer 1962) 95–104.

This paper discusses only those problems associated with manned missions and the critical problem of complete on-board navigation, and describes some of the general features of a complete on-board navigation and guidance scheme which might be used for a manned lunar mission. Although much work remains to be done on the guidance of a manned lunar vehicle, enough work has been done to show that a vehicle can be guided to the Moon, and then to a safe entry into the Earth's atmosphere.

THE SYNERGETIC PLANE CHANGE FOR ORBITING SPACECRAFT, by F. S. Nyland. Santa Monica, California, Rand Corporation, August 1962. 104 p. (Memorandum RM–3231–PR.)

Presents a preliminary analysis of a method for changing the orbital plane of a spacecraft operating in the vicinity of the Earth. The method utilizes aerodynamic forces as well as propulsive forces to effect such maneuvers and has been named a synergetic plane change. The study was developed in conjunction with the continuing work on space-operation problems. The conclusions should be of interest to strategy planners in the Air Force, specialists in the fields of atmospheric re-entry and trajectory analysis, advanced vehicle designers, and those government agencies concerned with space.

F. Industry-Government Cooperation

[MANAGEMENT GUIDE TO THE $30 BILLION MOON MARKET IN THE MANNED LUNAR LANDING PROGRAM], in *Aerospace Management*, v. 5, no. 6 (June 1962) 14–62.

"We are committed as a nation to the early and efficient exploration and exploitation of space. It may cost $30 billion, it may cost $50 billion to put man on the Moon . . . . The Ultimate cost will depend on how well the management talent in industry and government cooperates, how much skill it can exhibit in

simplifying complexity, and how quickly it can react to change." Contents: ENVIRONMENT . . . . A MASSIVE CHALLENGE IN MLLP; THE MANNED LUNAR LANDING PROGRAM . . . . HARDWARE; THE MEN WHO WILL DO THE JOBS; CRITICAL PATH IN THE MLLP . . . . FACILITIES; PROCUREMENT; NASA'S TWO-PRONGED MANAGEMENT CRUTCH (ATAT and GE); PATENT PQLICIES AND PROBLEMS IN MLLP; GUIDE FOR SUB-CONTRACTORS IN MLLP; QUALITY PROGRAM FOR THE MLLP; THE MILITARY—THE MOON—AND THE FUTURE; and THE MLLP MARKET . . . . A CROSS-SECTION OF THE CONTRACTORS.

[MILITARY SYSTEMS ISSUE], in *Missiles and Rockets,* v. 12, no. 12 (25 Mar 1963) 25–118 plus.

"During the past year, the reorganization of the Department of Defense has had growing impact in the U.S. Government and the missile/space industry. In this special issue, the editors of Missiles and Rockets present the first analysis from an industry point of view of the changes within the Pentagon. The first section of the issue is a report on the reorganization and how it has affected DOD policies and planning, procurement, and research and engineering. Part II tells how DOD approves a weapon system, how industry operates at the DOD level, how other Government agencies affect DOD decisions, and how critics assess the reorganization. Part III covers in detail the offices and agencies involved in Defense decision-making."

RELATING SCIENCE AND INDUSTRY TO GOALS IN SPACE, by James E. Webb, in *Signal,* v. 17, no. 4 (Dec 1962) 10–11.

Discusses the relationship of the private industrial community, and our institutions of higher learning, to the achievements of our goals in space.

THE SPACE INDUSTRY; AMERICA'S NEWEST GIANT. Englewood Cliffs, N.J. Prentice-Hall, 1962. 178 p.

By the Editors of FORTUNE. VOYAGE TO THE MOON; THE MILITARY CHALLENGE; NASA'S EARTHLINGS IN WASHINGTON; THE ANACHRONISTIC TOWN OF HUNTSVILLE; INDUSTRY'S TRIAL BY FIRE AT CANAVERAL; HITCHING THE ECONOMY TO THE INFINITE; A DEEPLY COMMITTED CORPORATION (North American Aviation); THE COMPANY ASTRIDE TWO WORLDS (General Electric); LAUNCHING A COMMUNICATIONS SYSTEM IN SPACE; CAN A MAN SURVIVE? (in space); ARE WE BEING HAILED FROM INTERSTELLAR SPACE.

[SPECIAL REPORT: NASA TELLS INDUSTRY ITS PLANS FOR THE NEXT DECADE], in *Missiles and Rockets,* v. 12, no. 7 (18 Feb 1963) 14–18.

Manned Spaceflight—Some Decisions Due This Year; Space Sciences—VOYAGER, Solar Probe Studies Next; Tracking—Work Starting Soon on New Antenna Net; Advanced Research —14 New Facilities Funded; Applications—Communications, Weather Stressed.

G. Launching and Launching Techniques

APPLICATION OF THE HYDRA-TYPE SEA LAUNCH TO VERTICAL PROBES, by Lt. Comdr. John E. Draim, in *Navigation,* v. 9, no. 1 (Spring 1962) 57–65.

Rockets used for high-altitude research, meteorological soundings, component testing, and range instrumentation checkout are being launched in increasing numbers on our national missile ranges. The US Naval Missile Center at Point Mugu, Calif., has been engaged in a broad program over the last two years aimed at the development of techniques for launching vertically floating rocket vehicles. This effort has been carried out under Project HYDRA (Sea-Launch). Discusses: adapting land-launch vehicles; HYDRA-launch advantages; HYDRA POGO–HI system; ocean launch sites; et cetera. It is the opinion of the author that many as yet unforeseen applications will justify the development of water-launch methods for rocket probes in all size and weight categories. Perfection of this launch method would greatly benefit the scientists and meteorologist by permitting remote launches with a minimum of equipment.

BOOSTER ORBITAL PIGGYBACK PAD STUDIED, by C. M. Plattner, in *Aviation Week and Space Technology,* v. 78, no. 11 (18 Mar 1963) 57–58 plus.

How low-cost, suborbital space research technique of enclosing sensors in piggyback pads on ATLAS boosters, developed for the Air Force, has led to design studies of an advanced pad capable of injecting a payload into orbit.

FUTURE LAND AND WATER LAUNCH FACILITIES, by Donald R. Johnson, in *Astronautics and Aerospace Engineering*, v. 1, no. 2 (Mar 1963) 45–51.

Discusses how diminishing land sites and the growing dangers in large rocket launchings, as well as the size of the vehicles themselves, show the value of consolidated launch facilities now and off-shore launch complexes for the future.

ITL AND TITAN III, by Col. Joseph S. Bleymaier, in *Astronautics and Aerospace Engineering*, v. 1, no. 2 (Mar 1963) 33–36.

How the need to cut down on checkout and pad time, service a variety of payloads, save real estate, up launch rates and lower costs, produced ITL (Integrate-Transfer-Launch) concept for TITAN III, and may affect other launch facilities.

[LARGE LAUNCH VEHICLES], in *Astronautics*, v. 8, no. 1 (Jan 1963) 26–32 plus.

This report on large launch vehicles is composed of the following six papers: NONRECOVERABLE BOOSTERS, by Richard B. Canright and Norman Rafel (The US stable of rocket vehicles now seeing development and use will run well into the 1970's, and departures from this main course of investment should not be expected early.); STRUCTURES AND MATERIALS IMPASSE? by William A. Mrazek (More than ever before, the designer finds himself "boxed in" by formidable walls—hard limits set up as Manrating, Reliability, Performance, State of Technology, Schedule, and Cost.); COST-OPTIMIZING MULTISTAGE ROCKETS, by Paul R. Hill (Selection of a booster system and its optimum rocket sizes should be based on the economics of achieving the mission.); THOUSAND TONS TO ORBIT, by Robert C. Truax (A 20,000-ton recoverable sea-launch rocket may allow the cheap payload-delivery costs required to make extensive manned lunar and planetary programs practical.); REUSABLE LAUNCH SYSTEMS, by Leonard M. Tinnan (Whatever the budget limits, development of a winged, recoverable rocket-powered launch system capable of orbiting Saturn-class payloads looks practical now, from available technology.); EVOLVING SOLID BOOSTERS FOR SPACE MISSIONS, by William Cohen (System studies have established big solids as real contenders for space vehicles capable of delivering 250–500 tons to orbit.).

LAUNCHING THE MOON ROCKET, by Kurt H. Debus, in *Astronautics and Aerospace Engineering*, v. 1, no. 2 (Mar 1962) 20–32.

LC–39 complex of launch facilities for advanced SATURN C–5 marks major advance over past operations with combination of automatic checkout in industrial-like environment, movement of ready vehicles to multipad complex, and remote control of launch itself. Since the problems related to launch operations are LOC's (Launch Operations Center, located at the Atlantic Missile Range) responsibility, the scope of this article is limited to concepts, techniques, and facilities for the launch of the SATURN-APOLLO space vehicle.

NASA PROGRAM DEVELOPS F–104A SOUNDING ROCKET LAUNCH METHODS, by Edward H. Kolcum, in *Aviation Week and Space Technology*, v. 78, no. 9 (4 Mar 1963) 57 plus.

Some data on technique for using a Lockheed F–104A aircraft as the first stage booster for sounding rockets,—developed by NASA at Flight Research Center, Edwards, California.

NAVY PONDERS TACTICAL SEA LAUNCHES, in *Missiles and Rockets*, v. 11, no. 21 (19 Nov 1962) 35.

Navy officials are taking renewed interest in sea launch of tactical payloads into space with award of a second contract in this field. The contract calls for a feasibility study of launching both research and development and tactical payloads. The study, already underway, will cover motion studies of hulls, launching dynamics, launching techniques and the arrangement of shipboard complex. Also discussed in this paper: advantages of sea launch, astronautics ship concept, and launch vehicles.

OCEAN LAUNCHING OF LUNAR AND INTERPLANETARY SPACE VEHICLES, by Raymon W. Hallet, Jr. and Joseph M. Tochingi, in *Navigation*, v. 9, no. 1 (Spring 1962) 21–34.

The authors review the characteristics of high-thrust nuclear rockets, the type of vehicle shape to be employed for manned lunar and interplanetary missions, and suggest some of the advantages associated with ocean launchings of high-thrust nuclear rocket space vehicles.

TOWARD THE ORBITAL LAUNCH FACILITY, by Georg F. von Tiesenhausen, in *Astronautics and Aerospace Engineering*, v. 1, no. 2 (Mar 1963) 52–57.

Flexible OLF (orbital launch facility) with separate laboratory and launch units, will prove highly desirable by the decade's end. It would introduce major challenges of orbital checkout.

H. Materials and Structures

ADVANCED PRODUCTION, by Irwin Stambler, in *Space/Aeronautics*, v. 39, no. 4 (Apr 1963) 85–88.

The materials that will work best in space "unfortunately just aren't easy to work with for us." However, a host of techniques have been developed to cope with the exotic problems they pose.

CORROSION IN MISSILES, by Leo E. Gatzek, in *Ordnance*, v. 46, no. 252 (May–June 1962) 829–832.

In our modern strategic defense concept intercontinental ballistic missiles will be housed in hardened underground silos, ready for firing at a moment's notice. The author tells how the prolonged storage of the weapons under these conditions is conducive to rust, oxidation of electrical contacts, deterioration of rubber parts, and the impairment of aluminum, plastics, and other materials employed in today's modern armament.

FABULOUS INFLATABLES, in *Modern Plastics*, v. 40, no. 2 (Oct 1962) 99–103 plus.

"Versatile and rugged industrial plastics films and laminations have proved their worth in inflatable structures headed for outer space as well as on the ground. Involved are polyethylene, polyester, vinyl and oriented polypropylene. And applications range from exotic passive satellite communications balloons to Earth-bound warehouses for industry. Special tip-on previews ingenious skin of soon-to-be launched ECHO-type satellite.

THE FIRST HUNDRED SECONDS, by Richard V. Rhode, in *Astronautics*, v. 7, no. 6 (June 1962) 14–18.

During the first one to two minutes of a space-vehicle's flight major forces on the vehicle occur and the potentiality for structural failure is greatest. In the first hundred seconds of flight we see much of the state of launch-vehicle structural technology dynamically displayed, and much that implies necessity for improvement. The author draws attention to aspects of launch-vehicle structures and materials that bear importantly on prospects for improving the state of the art.

[HIGH TEMPERATURE ISSUE], in *Aerospace Engineering*, v. 22, no. 1 (Jan 1963) 5–209.

This single-topic issue of Aerospace Engineering contains "the latest thought and accumulation of technical data in many areas of high temperature problems." The collection of articles by various authors deal with the following subject areas: the aerospace high temperature environment; aerospace materials in the high temperature environment; aerospace structural design in the high temperature environment; aero-elasticity effect of high temperatures; and high temperature test facilities, testing and test evaluation.

[MATERIALS FOR SPACE TECHNOLOGY SYMPOSIUM ISSUE], in *British Interplanetary Society Journal*, v. 18, no. 9 (May–June 1962) 319–382.

A symposium on material in space technology, organized by the Society, was held in London on 22 Nov. 1961. Details of the program are given and the following papers and discussions are presented in this issue: A GENERAL SURVEY OF THE MATERIALS PROBLEM, by A. J. Murphy; POLYMERS IN SPACE, by N. H. Langton and A. L. Soden; MAGNESIUM IN SPACE TECHNOLOGY, by E. F. Emley; ALUMINUM IN SPACE ENGINEERING, by E. G. West; HIGH-STRENGTH STEELS, by F. J. Wilkinson; THE DEVELOP-

MENT OF NOZZLE MATERIALS, by D. Bunting; THE USE OF GRAPHITE IN SPACE TECHNOLOGY, by A. E. S. White and R. K. Hurden; and THE EFFECT OF RADIATIONS ENCOUNTERED BY MATERIALS IN SPACE, by R. S. Barnes.

MATERIALS TESTING, by Henry E. Frankel, in *Western Aerospace*, v. 42, no. 7 (July 1962) 18–20.

A critical appraisal of current materials testing techniques and "some revealing case studies," in an attempt to answer such questions as: How reliable are laboratory "simulated space" environments? Are present materials testing techniques rigorous enough?

SPACE LOGISTICS, by H. A. Kilmer, in *Ordnance*, v. 47, no. 253 (July–Aug 1962) 105–107.

The coming era of extraterrestrial travel and exploration will demand a whole new concept of packaging supplies and equipment. Emphasis will be on light weight, compactness, and multiple uses. Reliability and environmental conditions also must be considered to ensure the success of our future astronautical journeys.

I. Orbits

DETERMINATION OF INTERPLANETARY TRANSFER ORBITS FOR SPECIFIED DATE OF DEPARTURE, by H. B. Schechter. Santa Monica, California, Rand Corporation, May 1962. 45 p. (Memorandum RM–2621–PR.)

This memorandum, the theoretical portion of which was completed in 1960, is intended to serve as a basic aid in studies of orbital mechanics. By presenting a relatively simple and straightforward method of optimum and non-optimum-orbit computation, it should be of use to the engineer concerned with preliminary mission analysis. In addition, the method of solution described here has pedagogical merit because it enables beginning students of orbital mechanics to solve assignments involving three-dimensional transfer orbits, without the need for machine computations.

SOME METHODS FOR ESTABLISHING INTERPLANETARY TRANSFER ORBITS, by L. N. Rowell. Santa Monica, California, Rand Corporation, March 1962. 63 p. (Memorandum RM–2881–PR.)

Geometry; equations of motion; outline of methods of computation; presentation and discussion of methods.

J. Powerplants, Propellants, and Propulsion

1. *Miscellaneous Aspects.*

ALL-SOLID-PROPELLANT INJECTION VEHICLES FOR LARGE-PAYLOAD SPACE MISSIONS, in *Astronautics*, v. 7, no. 10 (Oct 1962) 37–47.

A special staff report by the Jet Propulsion Laboratory of the California Institute of Technology, Pasadena, Calif.—In implementing its manned lunar-landing program, NASA has elected to use as its primary means of boosting the manned spacecraft to injection, an all-liquid-propellant vehicle, the Advanced SATURN. In its continuing efforts to examine future vehicle requirements, NASA is currently studying concepts for large launch vehicles capable of placing at least 500,000 pounds into orbit, i.e., a NOVA-class vehicle in support of a lunar station, planetary missions, et cetera. These new studies include vehicles based on all-liquid, both liquid stage and solid stage (hybrid), and all-solid propulsion systems, so that all can be evaluated if and when a decision is made to proceed with a NOVA development. In this connection the Jet Propulsion Laboratory under the auspices of NASA, has conducted studies of the all-solid system, and results indicate that it is unusually promising and of general interest. Accordingly this summarizing paper has been released.

ARPA PUSHES HYBRID RESEARCH, in *Missiles and Rockets*, v. 11, no. 19 (5 Nov 1962) 14 plus.

A rapidly accelerated program of research on hybrid rockets has been instituted by the Advanced Research Projects Agency in an effort to fill a major gap in US powerplant technology. Part of Project PRINCIPIA, an overall ARPA program to seek out advanced chemical propellants, the new surge of interest in hybrids has resulted in four major contracts being let, involving a fourfold increase in funding over last year. The contracts are each

aimed at serving the needs of individual services, while in sum total they cover the broad spectrum of ARPA's research goals.

DETONATION AND TWO-PHASE FLOW, ed. By S. S. Prenner and F. A. Williams. New York, Academic Press, 1962. 368 p. (Progress in Astronautics and Rocketry—Volume 6.)

Of interest to those working in the field of propulsion and research and development. Part I: DETONATIONS IN SOLIDS, LIQUIDS, AND GASES; Part II: TWO-PHASE FLOW

ENGINE MAY OUST BIG BOOSTER, by William Beller, in *Missiles and Rockets*, v. 12, no. 14 (8 Apr 1963) 12–13.

A hypersonic air-breathing engine is emerging as a potential challenge to large rocket boosters. The relatively small and lightweight engine will be able to accelerate a load from standstill to Mach 8 within a single mode of operation. The powerplant, known as air turbo-exchanger (ATE), is envisioned as a first-stage booster for orbital payloads and as the propulsion unit for an aerospace plane or hypersonic research vehicle.

ION PROPULSION, by Irwin Stambler, in *Space/Aeronautics*, v. 38, no. 7 (Dec 1962) 56–61.

For deep-space missions, electric propulsion appears essential, and even for many close-in missions it may provide the best powerplants. Among electric rockets, ion engines have progressed farthest—in fact, the major remaining development problem of ion propulsion concerns not the engines themselves but their power supplies. The report reviews the outstanding design problems that have had to be overcome in developing flyable ion engines, compares the two basic types of engines designed so far (which use surface and volume ionization respectively), and describes the current status of four current ion-engine programs. In addition, such future possibilities for ion propulsion as colloid ionization sources, isotope engines, and controlled-fusion power supplies are covered.

THE NAVY PROPELLANT RESEARCH PROGRAM, by Irving Silver, in *Armed Forces Chemical Journal*, v. 15, no. 2 (Mar–Apr 1962) 2–4 plus.

The Navy research effort in propellants as directed by the Bureau of Naval Weapons. Some of the pertinent aspects of the program with particular reference to propellants (solid and liquid) is discussed.

PROPULSION FOR INTERPLANETARY SPACE MISSIONS, by F. M. Kirby, in *Aerospace Engineering*, v. 21, no. 8 (Aug 1962) 22–30.

Fundamentals of interplanetary space missions—both scope and analysis—initiating from circular geocentric orbit are discussed. Planetary probes, planetary circular orbit establishment and planetary circular orbit establishment with return to Earth are covered. Vehicles and propulsion systems are described and a monograph method for analysis are given.

PROPULSION FOR SPACE VEHICLES: A SURVEY, by H. S. Seifert, in *Space Sciences Reviews*, v. 1, no. 2 (Oct 1962) 331–364.

This survey (a chapter in the book, SPACE LOGISTICS ENGINEERING, ed. by K. Brown and L. Ely, John Wiley and Sons, 1962) reviews: the central importance of propulsion, energy and mass consumption of rockets, propulsion requirements of various missions, fundamentals of thermal propulsion, state-of-the-art of thermal propulsion, and propulsion and logistics. With references and bibliography.

2. Electrical.

ELECTRIC PROPULSION, by Elliott Mitchell and Capt. R. J. Hayes, in *Spaceflight*, v. 4, no. 3 (May 1962) 81–85 plus.

Increasing attention is being focused on all phases of electric propulsion. In order to understand the potential of this type of propulsion and its relation to other propulsion systems, several aspects of the US space exploration program are considered. Systems considerations, thrust chamber development, et cetera.

[ELECTRIC SPACECRAFT DESIGN], in *Astronautics*, v. 7, no. 6 (June 1962) 20–30 plus.

The following series of articles in this issue of Astronautics is devoted to Electric Spacecraft Design: ELECTRIC SPACECRAFT—PROGRESS 1962, by David B. Langmuir (The ARS Electric Propulsion Conference reveals a

field "sure of its promise in space missions and driving to establish" efficiency and reliability in designs.); SYSTEMS ENGINEERING A NUCLEAR-ELECTRIC SPACECRAFT, by Robert J. Beale (Development progress on key components and formative direction from system studies move this class of spacecraft toward useful unmanned deep-space mission, perhaps by the end of the decade.); FEASIBILITY OF ARCJET-PROPELLED SPACECRAFT, by M. I. Yarymovych and others (Success with developmental engines already, and anticipation of data from space testing before long, underscores a need for many engineering studies to back system analysis, such as this, which indicated arcjet-propelled spacecraft can carry out several cislunar missions.); ELECTROSTATIC GENERATORS FOR SPACECRAFT, by A. S. Denholm and others (Knowledge for design of high-voltage vacuum-insulated generators has increased significantly, and they now look competitive for the power systems of early electric spacecraft.); and TOWARD COLLOID PROPULSION, by A. Lucile Cox (Goals of efficient and reliable propulsion for many space missions motivate research on heavy charged particle systems.).

ELECTRIC TOPS FOR HIGH-ENERGY TRIPS, in *Missiles and Rockets*, v. 10, no. 14 (2 Apr 1962) 34–35.

Scientists from the Jet Propulsion Laboratory, California Institute of Technology, told a recent Electrical Propulsion Conference of the American Rocket Society that an electrically propelled spacecraft with an initial weight of 45,000 pounds can perform every one of the 15 high-energy missions of interest to space scientists. Comparable chemical and nuclear-heat-exchange spacecraft can handle only seven and nine of these, respectively.

3. Nuclear.

NUCLEAR POWER IN SPACE, by Glenn T. Seaborg, in *Ordnance*, v. 47, no. 255 (Nov–Dec 1962) 290–293.

The coming Space Age will require many new and unusual devices and systems that were once considered science fiction. Dr. Seaborg states that chemical fuels will be replaced by atomic energy to supply the power and propulsion required for our deep-space probes and exploratory vehicles.

[NUCLEAR-ROCKET PROGRAM], in *Astronautics*, v. 7, no. 11 (Dec. 1962) 18–26 plus.

The following articles were collected and grouped together to present cross-sectional information on the nuclear-rocket program: MANAGING THE NUCLEAR-ROCKET PROGRAM, by Harold B. Finger (The aim of this far-flung effort, now engaging key government, industry, and technical interests, will be to make the nuclear rocket a major US asset in terms of both technology and space capability.); NUCLEAR-ROCKET APPLICATIONS, by Paul G. Johnson (The nuclear rocket will be the key to rapid, practical flight in deep-space missions—lunar ferrying, interplanetary round trips, solar-system probing, rescues, and satellite maneuvers.); NUCLEAR ROCKETRY—THE FIRST BRIGHT HOPES, by Robert W. Bussard; RIFT, by Col. W. Scott Fellows (The first nuclear-rocket vehicle, RIFT, moves toward flight tests on firm state-of-the-art ground, anticipating early application of nuclear propulsion to space exploration.); NUCLEAR-ENGINE DESIGN GOALS, by Charles H. Trent (As the NERVA program moves the nuclear rocket toward fruition, attention focuses on design and development goals for the engine, and specially its pumping system, controls, and destructor.); KIWI DEVELOPMENTAL TESTING, by Keith Boyer (The ROVER project, its reactor technology and facilities, stands ready to move into steady-state operations with liquid hydrogen.); and SAFETY AND OPERATIONS WITH NUCLEAR VEHICLES, by Lt. Col. Ralph S. Decker (Reactor handling causes no hazard, crews in flight face no new risk; chief problems center around premature, random re-entry and impact.).

[SPECIAL REPORT: NUCLEAR POWERPLANTS], in *Space/Aeronautics*, v. 37, no. 4, (Apr 1962) 60–81 plus.

This special report is composed of the following articles: THE ATOM AND SPACE, by Irwin Stambler; NUCLEAR ROCKETS, by Robert Fox; SECONDARY NUCLEAR POWERPLANTS, by Kenneth P. Johnson; MATERIALS FOR NUCLEAR POWERPLANTS, by John G. Fisher; NUCLEAR POWERPLANT CONTROL; by John W. Larson.

K. Re-entry and Landing

'CONALOG' PROPOSED AS MOON LANDING GUIDE, by Charles D. LaFond, in *Missiles and Rockets*, v. 10, no. 20 (14 May 1962) 31 plus.

"U. S. space voyages may be provided with a simulated roadway or corridor to follow—instead of facing endless hours of visual monotony during extended space missions." Two companies have developed prototype hardware for such a system. Called Contact Analog, or CONALOG, the two systems are in essence the same consisting of a TV display and a computer for storage and generation of navigation information and control parameters and for processing in-flight sensory inputs or course changes.

'MATCON' TO BRING BACK X–20A'S, by Charles D. LaFond, in *Missiles and Rockets*, v. 12, no. 4 (28 Jan 1963) 32–33.

Vehicle recovery in next year's unmanned X–20A airdrop and Earth-orbital flights will be accomplished through use of a new microwave ground terminal control system. Now in the equipment design phase, the system—called MATCOM for Microwave Aerospace Terminal Control—will be ready for test operation early in 1964 at Edwards Air Force Base, Calif., using jet drones.

NEW RE-ENTRY SHAPES, by H. Julian Allen, in *Space/Aeronautics*, v. 39, no 4 (Apr 1963) 81–83.

"At the speeds of manned spacecraft, cones may replace the blunt re-entry bodies made familiar by ballistic missiles. So says one expert —the inventor of the blunt nose."

PROJECT FIRE DESIGN NEARING COMPLETION, by Warren C. Wetmore, in *Aviation Week and Space Technology*, v. 77, no. 25 (17 Dec 1962) 53 plus.

Design of the re-entry vehicle for the NASA's Project FIRE—intended to obtain re-entry data at velocities approaching 37,000 Fps., which will be applicable to Project APOLLO and later missions—is now about 95% complete. Some initial fabrication already has begun. Purpose of the tests is to measure total and radiative heat transfer, materials behaviour, and radio signal attenuation (re-entry blackout) at speeds greater than escape velocity at which future spacecraft returning from lunar interplanetary missions will re-enter the Earth's atmosphere. The primary area of uncertainty is in the problem of radiative heat. Also discusses: re-entry velocities, the launch vehicle, second stage design, et cetera.

SHOCK MITIGATION SYSTEMS ANALYZED, by John F. Judge, in *Missiles and Rockets*, v. 10, no. 25 (18 June 1962) 26 plus.

How dynamic scale-modeling provides an effective tool for the study of lunar landing.

SOME ABORT TECHNIQUES AND PROCEDURES FOR MANNED SPACECRAFT, by John M. Eggleston, in *Aerospace Engineering*, v. 21, no. 11 (Nov 1962) 17–26.

This paper is concerned with our present state of knowledge on the procedures and effectiveness of aborts from manned orbital and lunar missions. By abort is meant a deliberate or unintentional termination of the primary mission followed by an expedient return to Earth of the payload (spacecraft and crew).

L. Scientific and Engineering Manpower

CAREERS IN ASTRONAUTICS AND ROCKETRY; TRAINING AND OPPORTUNITIES IN THE SPACE AND MISSILE FIELDS, by Carsbie C. Adams and Wernher von Braun. New York, McGraw-Hill, 1962. 252 p.

The evolution of astronautics and rocketry; astronautics and the natural sciences; astronautics and the engineering discipline; training for astronautical careers; careers in industry; careers in research institutes and universities; careers in the Civil Service and military astronautics; and astronautics and the future. Appended a list of professional astronautical, rocket, and related societies; and additional sources of career information.

PEENEMÜNDE TO CANAVERAL, by Dieter K. Hunzel. Englewood Cliffs, N. J., Prentice-Hall, 1962. 247 p.

The rise and death of Peenemünde, the German rocket development effort that went on there, how the Germans hid the documents pertaining to rocketry as the war was being lost by them, then made contact with American

Forces and turned everything over to them, the subsequent arrival of German scientists and technicians in the United States (the author was one of them) and their activities and work up to the time when REDSTONE NO. 1 was launched at Cape Canaveral. Appended: historical notes on rocketry in Germany.

SCIENTIFIC MANPOWER 1961. Washington, National Science Foundation, 1962. 30 p. (NSF 62–22.)

Selected papers delivered at the 1961 Annual Meeting of the American Statistical Association and the American Association for the Advancement of Science. The papers are: THREE YEARS AFTER THE HOUSE COMMITTEE REPORT ON SCIENTIFIC AND TECHNICAL PERSONNEL DATA, by Thomas J. Mills; PERIODIC ESTABLISHMENT SURVEYS OF EMPLOYMENT IN SCIENCE AND ENGINEERING, by Robert W. Cain; STUDIES OF DEMAND FOR SCIENTIFIC AND TECHNICAL PERSONNEL, by Harold Goldstein; CENSUS-RELATED STUDIES OF SCIENTIFIC AND TECHNICAL PERSONNEL, by Seymour Warkov; and ENGINEERING AND SCIENCE—A STRUGGLE FOR SURVIVAL, by Truman H. Kuhn.

UNIVERSITY SPACE SUPPORT ROLE EXPANDS, by Warren C. Wetmore, in *Aviation Week and Space Technology*, v. 77, no. 21 (19 Nov 1962) 207 plus.

Dependence on universities to provide manpower and fundamental research for the US space program is shaping a new relationship between the government and colleges. This view was presented "recently" by a university spokesman at the first NASA-University Conference on the Science and Technology of Space Exploration in Chicago. Purpose of the conference was to inform college administrations and faculties of NASA's need for higher caliber research and better trained students to meet national goals in the exploration of space. NASA hired about 600 engineering and science graduates in June of 1962 and will increase this number next year to fill its expanding needs.

WHAT ABOUT WOMANPOWER IN THE SPACE AGE? by Erwin R. Steinberg, in *Air Force*, v. 45, no. 8 (Aug 1962) 56–58.

"If space-age technology is really as short of trained personnel as we are repeatedly advised, why aren't women with will and brains accepted for significant scientific and technical roles? If there really is a shortage of top-flight people, then society must overcome its preconceived prejudices and notions about women in technology."

M. Tracking

CURRENT LIMITATIONS OF TRACKING SYSTEMS FOR LONG-RANGE MISSILES, by Jean-Claude Simon, in *Interavia*, v. 17, no. 8 (Aug 1962) 999–1001.

The principles on which radar systems work, and the causes of error.

THE FUTURE OF RADAR, by James Holahan, in *Space/Aeronautics*, v. 39, no. 3 (Mar 1963) 84–92.

"Have requirements gotten too tough? Can radar solve the anti-missile problem? Has it a future in space surveillance and tracking? In spacecraft systems?" These questions and others were put to the top designers and marketers of 7 leading organizations in the radar field who present their opinion.

RADAR FOR SATELLITE TRACKING, by E. K. Stodola, in *Missiles and Space*, v. 10, no. 6 (June 1962) 16–19 plus.

The problem of long range, accurate tracking of space vehicles is assuming ever increasing importance as the tempo of our space program increases. This article discusses a radar system (VERLORT—Very Long Range Tracking) successfully used in current satellite program.

RADIO-OPTICAL OBSERVATORY SET UP FOR DEEP-SPACE EXPERIMENTS, by R. E. Anderson and J. F. Spalding, in *Space/Aeronautics*, v. 37, no. 5 (May 1962) 211 plus.

Reports on a radio-optical observatory where lunar and ECHO satellite reflection is being studied to determine the effective bandwidth of the propagation paths. Describes the observatory's equipment and reviews findings from the work being done there.

SATELLITE TRACKING, by Stanley J. Macko. New York, John F. Rider Publisher, Inc., 1962. 178 p.

This book is an attempt to introduce the reader to the concept of satellites to present an understanding why satellites are launched, how they are launched, why they behave as they do, et cetera. Contents: THE PLANETS—HISTORY AND BACKGROUND; WHAT KEEPS SATELLITES UP, AND ACCURACIES NECESSARY TO ATTAIN THE DESIRED ORBIT; RELATING THE ORBITAL PLANE TO THE EARTH; ORBITAL ELEMENTS OF A SATELLITE; HOW TO COMPUTE THE APPROXIMATE ORBITAL ELEMENTS OF A SATELLITE; ORBITAL ELEMENTS FROM TRACKING DATA; HOW TO USE ORBITAL ELEMENTS; VISIBILITY OF SATELLITE AND MISSILE ORBITS; BALLISTIC MISSILE TRAJECTORIES; THE ATLANTIC MISSILE RANGE; et cetera.

V. SPACE EXPLORATION: NEW VISTAS

A. Miscellaneous Aspects

ASTRONOMICAL PHOTOGRAPHY, by Gerard De Vaucouleurs. New York, Macmillan, 1961. 94 p.

From the Daguerreotype to the Electron Camera. The chapters are: I—THE BEGINNINGS OF ASTRONOMICAL PHOTOGRAPHY: 1839–1851; II—THE DEVELOPMENT OF ASTRONOMICAL PHOTOGRAPHY: 1851–1879; III—THE RISE OF ASTRONOMICAL PHOTOGRAPHY FROM 1879 TO 1887; IV—PROGRESS IN ASTRONOMICAL PHOTOGRAPHY SINCE 1888; V—THE PRESENT AND FUTURE OF ASTRONOMICAL PHOTOGRAPHY. With 21 plates. Bibliography.

THE FUTURE, by E. G. D. Andrews, in *Spaceflight*, v. 5, no. 1 (Jan 1963) 25–30.

"Detailed assertions of probable future developments in spaceflight are unprofitable for they will certainly be proved wrong by events .... Prediction of many events in the next decade is fairly easy, however, because of in this most advanced of all technologies the gestation of any endeavour is necessarily several years, and the events are already determined by developments in hand .... As yet, there is little indication that any nations, other than the two principals [US and USSR], have fully realized the importance of the current developments." The author discusses: technological incentives, ballistic missiles, defensive weapon systems, military interest in space programs, space research program, manned projects, et cetera. Most of the programs that are described "will be completed by the 1970's: the difficulty is to decide what will happen after that."

LIFTING VEHICLE PROBLEMS ATTACKED, by William Beller, in *Missiles and Rockets*, v. 11, no 19 (5 Nov 1962) 17–18.

The post-APOLLO challenge of devising lifting vehicles to enter planetary atmospheres is demanding research as new and strange as the environment to be studied. One major result is that inter-discipline attacks are being mounted against the technical problems involved. The first organized meeting occurred in Phila. in October at the "Symposium on Dynamics of Manned Lifting Planetary Entry," jointly sponsored by the Air Force Office of Scientific Research and the Space Sciences Laboratory of General Electric Co. Some of the discussions revolved around: pre-stressed pyrolytic graphite, plasma power, re-entry shapes, Venusian atmosphere, transmitting through plasma, et cetera.

MARTYRS ON THE MOON? by Carl Dreher, in *Harper's Magazine*, v. 226, no. 1354 (Mar 1963) 34–38.

"Unless we slow down our race to get to the moon, the first Americans we send probably won't come back alive .... A cold-eyed assessment by an engineer who has closely followed our efforts to explore space."

1001 QUESTIONS ANSWERED ABOUT SPACE, by Clarke Newlon. New York, Dodd, Mead, 1962. 355 p.

In the foreword the author states: "....The material for 1001 Questions Answered About Space comes from 1001 sources, all open and unclassified. They included reports, papers and studies from the National Aeronautics and Space Administration, the Department of Defense, the three Military Services, the Atomic Energy Commission, the National Academy of Sciences and both Houses of Congress; from innumerable conversations with government officials, university scientists, industry repre-

sentatives, researchers and engineers." With chapters on: what space means to you; the cosmic bodies; the language of space; the history of space exploration; the techniques of space exploration (including telemetry guidance, inertial guidance, materials, re-entry vehicles); space power sources; US space-launched vehicles; unmanned space systems; manned space systems; the human side of space; the search for life in space; space and the future; the military in space; space and the law; conquering space through research; the US space agencies; and biographies.

PROPULSION FOR INTERPLANETARY SPACE MISSIONS, by F. M. Kirby, in *Aerospace Engineering,* v. 21, no. 8 (Aug 1962) 22–30.

Fundamentals of interplanetary space missions—both scope and analysis—initiating from circular geocentric orbit are discussed. Planetary probes, planetary circular orbit establishment and planetary circular orbit establishment with return to Earth are covered. Vehicles and propulsion systems are described and a monograph method for analysis are given.

SPACE: FRONTIER UNLIMITED, by Harold Leland Goodwin. Princeton, D. Von Nostrand Co., 1962. 144 p.

The author presents an introduction to the major considerations in space exploration. The first chapter sums up the geography of space, while chapters two through five attempt to summarize the principal elements of scientific research, practical applications, political and military effects, and the impact of space on society. The final chapter "is a brief excursion into the possible future of space exploration." With glossary and bibliography.

SPACE FLIGHT REPORT TO THE NATION, ed. by Jerry Grey and Vivian Grey, New York, Basic Books, 1962. 224 p.

In foreword to the book Wernher von Braun states: "Space Flight Report To The Nation" recapitulates the American Rocket Society's massive effort to inform the American people of our rapidly accelerating space program. In this volume, our space vehicles are described by leading scientists and engineers in the field of vehicle engineering, and their scientific and exploratory missions are explained by equally well-qualified individuals. In addition to the scientific and engineering aspects of astronautics, the all-important global influences of astronautics are discussed in terms of their military, political, and economic effects. And since no report to the nation on space flight would be complete without some mention of the so-called space race between the United States and the Soviet Union, a panel discussion on this topic also is included. In short, we have here a book which sums up the status of astronautics as it exists today." The chapters are: 1. THE MISSIONS. 2. THE VEHICLES. 3. THE GLOBAL EFFECTS (Military Effects; Political Effects; Industrial-Economic Effects; International Cooperation; Extraterrestrial Contact.) 4. THE U.S. AND THE U.S.S.R. The book includes a glossary of space terminology.

SPACE LOGISTICS FROM EARTH TO MARS, by William R. Woodward, in *Military Engineer,* v. 54, no. 360 (July–Aug 1962) 264–268, no. 361 (Sept–Oct 1962) 354–357.

"There is an urgent need for preparation of plans to ensure synchronization of design, operations, and logistic support from concept to exploration. There is also a need to develop and educate a logistic engineering breed of planners capable of advancing in unison with the progress in design. The development of long-range objectives to conquer space, as a matter of extreme urgency, is essential. Logistics is a vital part of space travel projects. There is a need to train design and operations personnel in the importance of logistics and timely guidance." The article discusses such pertinent facets relative to space logistics as: planning, concept of operations, features of Mars, the trip, SMAC (Space Maintenance Analysis Center), RAMS (space depot), communications, boosters, basing, life support, support equipment, space equipment, and personnel and training.

SPEAKING OF SPACE, ed. by Richard M. Skinner and William Leavitt. Boston, Little, Brown, 1962. 278 p.

An anthology of the best from SPACE DIGEST. The chapters are: One—THE VASTNESS AND THE MYSTERY OF THE COSMOS; Two—MAN'S PLACE IN THE UNIVERSE; Three—THE IMPACT OF TECH-

NOLOGY; Four—MAN AND MACHINE IN SPACE; Five—ECONOMIC IMPLICATIONS; Six — POLITICAL - MILITARY SIGNIFICANCE; Seven—NEW WORLDS FOR A NEW AGE. With a missile and space glossary by the Editors of the Air Force/Space Digest.

B. Environmental Aspects

ASTRONAUT PROTECTION THEORIES REPORTED, by Cecil Brownlow, in *Aviation Week and Space Technology*, v. 77, no. 20 (12 Nov 1962) 73 plus.

Methods for protecting crew members from hazards of radiation and predicted debilitating effects of weightlessness during prolonged interplanetary or orbital flights were subjects of major concern to leading Western and Eastern bloc scientists in Paris for the International Symposium on "Basic Environmental Problems of Man in Space." Some of the views presented and reports of discussions are touched on.

THE BIOLOGY OF SPACE TRAVEL, ed. by N. W. Pirie. London, Institute of Biology, 1961. 120 p.

Biological effects of partial and of complete weightlessness; maintenance of life in space ships—thermal environment, synthesis, recycling and the step towards a microcosm, and food problem; radiation in space and its effects on man; psychological problems of solitude and confinement; the problems of astronaut selection; the human brain in space time; dangers of contamination of the Moon and the Earth; and the probable environment on other planets and its suitability for some forms of life.

[ENVIRONMENT IN SPACE], in *Astronautics*, v. 7, no. 8 (Aug 1962) 14–23 plus.

The following series of articles collected for this issue of Astronautics deal with environment in space: SOLAR RADIATION, by Herbert Friedman (An average yellow star dominates the environment of our space, its radiations both sustaining life and posing danger to manned space operations.); MAGNETIC FIELDS IN SPACE, by Charles P. Sonett (The field of cosmic electrodynamics looks forward to experiments in the true galactic arm.); DUST AND METEORITES, by Fred L. Whipple (Fine material and etching rates command attention for their influence on spacecraft design.); COSMIC RAYS AND THE INTERPLANETARY MEDIUM, by Thomas Gold (Although tenuous, the interplanetary matter shows consequential properties and dynamics.); ANNOUNCING THE U.S. STANDARD ATMOSPHERE—1962, by Norman Sisenwine; ATMOSPHERIC STRUCTURE, by Francis S. Johnson; and AURORA AND AIRGLOW, by Joseph W. Chamberlain (Rockets and satellites provide the means to crack the still mysterious behavior of these phenomena.).

THE FUTURE STATURE OF LIFE SUPPORT SYSTEMS, by Norman Belasco, in *Aerospace Engineering*, v. 21, no. 9 (Sept 1962) 86–87 plus.

Problems of environmental control, personal protection and support, food and water supplies, and waste management and personal hygiene are reviewed. The present status and predictions for the next three stages of evolution for operational equipment and R & D efforts are delineated for each major subsystem. Throughout the equipment evolutions predictions, pertinent example activities are identified and briefly described. It is intended that recognition of equipment requirements and analysis of potential solutions should encourage early R & D activity.

HAZARDS OF SPACE FLIGHT, by Jan Paul, in *Ordnance*, v. 46, no. 251 (Mar–Apr 1962) 703–705.

With our present state of knowledge, the spacecraft shielding necessary to protect an astronaut against radiation from the Van Allen belt, cosmic rays, and solar flares is almost prohibitive. However, Dr. Jan Paul indicates that further research may reveal that larger radiation doses are permissible, making deep space voyages possible with our available capabilities

MAN IN PLANETARY OPERATIONS, by Albert A. Glass, in *Military Engineer*, v. 55, no. 363 (Jan–Feb 1963) 1–4.

Man's part in space flights is to serve three functions: he will be a scientific specimen, a scientific observer, and a functioning component within a space system. It is necessary, therefore, to know what man's capabilities are in space (1) before his role can be decided, (2) before criteria can be developed for deciding when a space vehicle should be manned or un-

manned, (3) before space flight conditions can be simulated, (4) before functions can be allocated, and (5) before the selection and training of man for space operations can proceed with confidence. The paper discusses: ecology; behavior and performance, acceleration and deceleration, weightlessness, vision, hearing, et cetera.

MAN'S DEPENDENCE ON THE EARTHLY ATMOSPHERE, ed. by Karl E. Schaefer. New York, Macmillan, 1962. 416 p.

Proceedings of the First International Symposium on Submarine and Space Medicine, which was sponsored by the Advanced Research Projects Agency in cooperation with American Institute of Biological Sciences under ONR contract Nonr 2673(00). The symposium provided a comprehensive review of the latest pertinent developments in the field of environmental physiology and cited the problem areas in which research is urgently needed.

OPTIMAN FOR THE SPACE AGE, by Toby Freedman and Gerald S. Linde, in *Air Force*, v. 46, no. 1 (Jan 1963) 43–46.

"Can man be modified?" Under the stresses of hard environments, people have empirically developed 'superhuman' abilities, as represented by Tibetan acclimatization to extreme cold, Yogi ability to withstand extreme heat, Andes Indian habitation at superaltitude. Spaceflight may well require the orderly, scientific development of physical and metal skills that will make of man . . . . Optiman for the Space Age."

SCHIRRA REPORTS ON MA-8 FLIGHT SUCCESS, in *Aviation Week and Space Technology*, v. 78, no. 7 (11 Feb 1963) 55 plus.

Navy Comdr. Walter M. Schirra, Jr. made the third manned US orbital flight on 3 Oct. 1962 in the Sigma 7 spacecraft. This is Comdr. Schirra's pilot report on the six-orbit flight in which he discusses: countdown and boost, orbital flight, relative motion, suit valve increase, cloud coverage, retrofire stability, communications, landing, et cetera.

SPACE MEDICINE, by Ursula T. Slager. Englewood Cliff, N. J., Prentice-Hall, 1962. 388 p.

Man's entry into space; the pressure of environment; the temperature environment; the radiation environment; nonionizing radiation and ionizing radiation; acceleration and deceleration; weightlessness; noise and vibration; metabolism; toxicology; psychology; and ecology of other planets and interplanetary space.

SPACE RADIATION, ITS NATURE AND PROPERTIES, by A. J. Mosley and A. D. Goedeke, in *Aerospace Engineering*, v. 21, no. 6 (June 1962) 21–31.

Discoveries as a result of IGY investigations have complicated the picture of space radiation considerably. A summary of these discoveries, as well as the results of recent Van Allen zones measurements, and a detailed analysis of several major solar cosmic-ray events are included in this presentation.

TO SPIN OR NOT TO SPIN, by Eugene F. Lally, in *Astronautics*, v. 7, no. 9 (Sept 1962) 56–58.

A major obstacle confronting man's serious participation in the exploration of space could be his response to long periods of weightlessness. "It is unfortunate that we are on the threshold of designing spacecraft in which man will have to survive months and years, fully realizing that we have little information on his reactions to prolonged weightlessness."

U.S., REDS SHARE VIEW OF SPACE NAUSEA, by Heather M. David, in *Missiles and Rockets*, v. 10, no. 20 (14 May 1962) 17 plus.

At a May 1962 meeting of the Committee on Space Research (COSPAR), Glenn and Titov delivered accounts of their flights. Other reports covered radiation and exobiology.

VESTIBULAR SCREENING OF ASTRONAUTS URGED, by Cecil Brownlow, in *Aviation Week and Space Technology*, v. 77, no. 21 (19 Nov 1962) 102–103 plus.

"Reliable means of detecting and weeding out or curing space flight candidates with a marked susceptibility towards vestibular disturbances during flight, such as those experienced by Russian Cosmonaut Maj. Gherman Titov, are under urgent study" in both the Soviet Union and the United States.

WEATHER IN SPACE; UNSETTLED TODAY, WARMER TOMORROW? by J. S. Butz, Jr., in *Air Force*, v. 45, no. 10 (Oct 1962) 39–43.

One of the hazards to manned spaceflight is "weather—a new kind of weather, quite different from the disturbances that have plagued flyers inside the earth's atmospheric envelope for a half-century." Space "weather" is characterized by the perils of solar wind, galactic cosmic rays, Van Allen radiation, solar flares, et cetera. Before the first manned missions to deep space, we need to know much more about weather in space.

WEIGHTLESSNESS STILL WORRIES SOVIETS, by Heather M. David, in *Missiles and Rockets*, v. 11, no. 18 (29 Oct 1962) 27.

Concern is voiced over effects of prolonged flight on blood production and tissue regeneration.

WHAT DOES "WEIGHTLESSNESS" REALLY MEAN? by Edward W. Jones, in *Space/Aeronautics*, v. 38, no. 5 (Oct 1962) 65–67.

"Few phenomena of space flight are talked about as glibly as 'weightlessness'—but much of the talk is on the hazy side." This article offers a quick, basic review of the problems of weight and weightlessness in space as they affect human factors as well as equipment design. It analyzes the distinct cases of suborbital, orbital, and space flight, and notes, among other points, that "zero gravity" is really a misnomer.

C. Exploring the Planets

1. Moon and Lunar Missions.

AMERICAN ON THE MOON: THE ENTERPRISE OF THE SIXTIES, by Jay Holmes. Philadelphia, J. B. Lippincott, 1962. 272 p.

Seeks to give a broad picture of the why and the how of American activities in space, with emphasis on the civilian portion. The chapters are: I—QUESTIONS; II—THE EARLY SPACE YEARS; III—SOME BENEFITS EN ROUTE; IV—TO THE MOON; V—THE FUTURE. Appendices deal with: present and proposed US launching rockets; US scientific satellite and deep-space probe projects; US military satellites; US communications satellites and related experiments; US weather satellites—research and development; US weather satellite plans—operational.

AMERICA'S RACE FOR THE MOON; THE NEW YORK TIMES STORY OF PROJECT APOLLO, ed. by Walter Sullivan. New York, Random House, 1962. 163 p.

This book is based on a series of articles on the APOLLO program which appeared in The New York Times. Partial contents: PROLOGUE—TO THE MOON—A CENTURY AGO, by Walter Sullivan; WE ARE GOING, by Richard Witkin; WHO IS DOING THE JOB? by Richard Witkin; HOW TO GET THERE, by Harold M. Schmeck, Jr.; PROJECT GEMINI—LEARNING TO LIVE IN SPACE, by Harold M. Schmeck, Jr.; SPACEPORT U.S.A., by Walter Sullivan; TRACKING AND COMMUNICATIONS, by Walter Sullivan; MOON PIONEERS—SELECTION AND TRAINING, by Richard Witkin; WHAT WILL THE MOON BE LIKE, by Walter Sullivan; TASKS FOR THE FIRST EXPLORERS, by Walter Sullivan; SPACE INFECTION, by Harold M. Schmeck, Jr.; SOVIET ENIGMA, by David Binder. Appendix: Space Glossary, and Moon Facts.

ANYONE FOR THE MOON? by John D. Williams, in *Air Force*, v. 45, no. 6 (June 1962) 62 plus.

"Even though we may look back some day and consider that the Moon expedition was a Kitty-Hawk-class affair, we will also recognize it as a harbinger of great events, because it will have been a sizable investment in research —which pays off at a high rate in new knowledge. Also the feat will speak well for our society and its pattern of organization and, significantly, perhaps increase man's faith in himself. These are among the good reasons to answer yes to the question . . . . Anyone for the Moon?"

BY ROCKET TO THE MOON. Raketoi k lune, by V. I. Levantovskii. Moscow, Gosudarstvennoe Izdatel'stvo Fiziko-Matematicheskoi Literatury, 1960. 379 p. In Russian.

Rocket as a means of flight into cosmos; trajectories; Moon as the natural satellite of the Earth; trajectories for Moon landings; how to create an artificial satellite of the Moon; the stages of flight to the Moon; lunar flights in theory and reality; exploring the Moon and cosmic space; interplanetary flights. Photos

and other illustrations. Bibliography. (With much information about American space programs.)

THE CHEMISTRY OF THE LUNAR SURFACE, by Michael H. Briggs, in *British Interplanetary Society, Journal*, v. 18, no. 10 (July–Aug 1962) 386–389.

The possible chemical evolution of the lunar surface is discussed and the evidence for the presence of organic matter at the present time is reviewed.

THE CHEMISTRY OF THE MOON, by H. C. Urey, in *Armed Forces Chemical Journal*, v. 15, no. 2 (Mar–Apr 1962) 18–25.

Discusses: the on-going studies of the Moon since World War II; the composition of the Moon; history of the Moon surface; black lava on the Moon; theories of dust; et cetera.

CRITICAL BIO-ENGINEERING NEEDS FOR LUNAR MISSIONS, by Lt. Col. J. J. Rose, in *Aerospace Engineering*, v. 21, no. 4 (Apr 1962) 50–51 plus.

An outline of the bio-instrumentation and bio-technology requirements for lunar missions, with particular attention to the need of, requirements for, and advantages of a multipurpose space-flight control center and command control and guidance system.

ELECTRONIC SUPPORT SYSTEM FOR MANNED LUNAR MISSIONS, by R. A. Heartz, in *Aerospace Engineering*, v. 21, no. 10 (Oct 1962) 22–29.

Success and safety of manned lunar missions requires a global real-time electronic support system for vehicle command and control. Such a system is discussed and its capability to support the pilot and on-board guidance and navigation equipment during launch, rendezvous, injection into lunar transfer ellipse, reentry, energy management, and landing is illustrated. It is pointed out that this system is essential to provide the necessary flight safety for our astronauts flying unexplored missions in new and complex vehicles.

EXPLORATION ON THE MOON, by Lt. Gen. Walter K. Wilson, Jr., in *Army Information Digest*, v. 17, no. 6 (June 1962) 32–37.

Why Engineer construction studies and tests on Earth are a necessary preliminary to exploration on the Moon. Discusses technical planning, designing a facility, necessity of special techniques, and adapting men and machines.

'GREENCHEESE' VEHICLES PROPOSED AS MOON SAMPLERS, by Charles LaFond, in *Missiles and Rockets*, v. 11, no. 4 (23 July 1962) 22–23 plus.

Lunar surface samples can be brought to Earth and analyzed more easily, more efficiently and at considerably lower cost than they can be studied on the Moon. Sperry Gyroscope made a proposal, called Project GREENCHEESE, in mid-1961, whose purpose was to build a small prototype vehicle capable of obtaining lunar samples and returning to Earth. Sperry continued its studies, feeling that the project is not only feasible, but one that could be used to advantage in a program such as SURVEYOR. The author discusses: Design considerations, construction, initial return phase, return vehicle, re-entry conditions, et cetera.

HOW BAD IS THE MOON ENVIRONMENT, by M. A. Broner and G. A. Lander, Jr., in *Space/Aeronautics*, v. 37, no. 4 (Apr 1962) 92–96.

High vacuum, extreme temperature, solar and cosmic radiation, and meteorites and interplanetary dust—three major hazards of the lunar environment are known at least in general outline, though conclusive data are still lacking. This article reviews what information we have on them and in addition analyzes the effects of lunar gravity. It also describes the physical features of the Moon's surface, discussing in detail the question of the topmost dust layer. It points out how properly chosen sites can afford some protection against the lunar environment, and lists a series of landing sites that have been suggested.

AN INTRODUCTION TO SPACE TRAVEL, by P. E. Cleator. New York, Pitman, 1961. 160 p.

Includes chapters on problem of escape, orbits and destinations, extraterrestrial survival, and man on the Moon.

LUNAR BASING, by John DeNike and Stanley Zahn, in *Aerospace Engineering*, v. 21, no. 10 (Oct 1962) 8–14.

A permanent lunar base is discussed in terms of location, environmental factors, base size, power supply, surface vehicles, subsystems necessary for life support, and shelter and developmental problems.

[LUNAR EXPLORATION], in *Astronautics*, v. 7, no. 7 (July 1962) 14–18 plus.

This section of Astronautics includes the following four articles: THE MOON AND ITS INTERIOR, by Gordon J. F. MacDonald (Information derived from a lunar orbiter and surface experiments should bring long-awaited answers on the internal nature and origin of the Moon.); THE POLAR LUNAR BASE, by J. Green and others (Although not knowing yet precisely where to build a base on the Moon, we can deduce certain biological and geological advantages of the polar lunar base.); MEASURING LUNAR PROPERTIES FROM A SOFT-LANDER, by Manfred Eimer (A variety of instruments will analyze the Moon's texture, body structure, petrology, and other physical and chemical characteristics, as well as the nature of any "atmosphere" and fields.); and LUNAR TAKEOFF, by Kurt Stehling. (There will be no more critical phase of the manned lunar-landing mission, none more demanding in imagination and technology, than lunar takeoff.).

LUNAR MISSIONS REVIEWED, by C. I. Cummings and H. R. Lawrence, in *Astronautics*, v. 7, no. 10 (Oct 1962) 72–77.

A report on the American Rocket Society's midyear meeting, held in Cleveland, which gave a "cohesive view" of plans and technical progress on missions in the lunar program.

LUNAR RENDEZVOUS, by John C. Houbolt, in *International Science and Technology*, no. 14 (Feb 1963) 62–70.

This is the author's story of lunar-orbit rendezvous: how NASA almost elected another scheme and why he fought so hard for LOR. Also why it seems the quickest, cheapest, and most reliable way for man to visit the Moon.

LUNAR-SURFACE RENDEZVOUS, by W. J. Downhower and others, in *Astronautics*, v. 7, no. 10 (Oct 1962) 60–65.

Explored in early APOLLO studies, this scheme of man to the Moon and back through lunar-surface rendezvous employs several flexible modules and proven solid rockets to land and return a three-man party. The authors discuss: system advantages and goals; identification of mission requirements; system elements; command module (manned capsule); transit, landing and return module; environmental-control support capsule; mission module; propulsion module; landing-guidance accuracy; lunar refueling operations; above-the-surface transport; on-the-surface transport; mission schedule; and cost and funding requirements.

[MANAGEMENT GUIDE TO THE $30 BILLION MOON MARKET IN THE MANNED LUNAR LANDING PROGRAM], in *Aerospace Management*, v. 5, no. 6 (June 1962) 14–62.

"We are committed as a nation to the early and efficient exploration and exploitation of space. It may cost $30 billion, it may cost $50 billion to put man on the Moon .... The ultimate cost will depend on how well the management talent in industry and government cooperates, how much skill it can exhibit in simplifying complexity, and how quickly it can react to change." Contents: ENVIRONMENT .... A MASSIVE CHALLENGE IN MLLP; THE MANNED LUNAR LANDING PROGRAM .... HARDWARE; THE MEN WHO WILL DO THE JOBS; CRITICAL PATH IN THE MLLP .... FACILITIES; PROCUREMENT; NASA'S TWO-PRONGED MANAGEMENT CRUTCH (ATAT and GE); PATENT POLICIES AND PROBLEMS IN MLLP; GUIDE FOR SUBCONTRACTORS IN MLLP; QUALITY PROGRAM FOR THE MLLP; THE MILITARY—THE MOON—AND THE FUTURE; and THE MLLP MARKET .... A CROSS-SECTION OF THE CONTRACTORS.

MANAGING MAN'S GREATEST ADVENTURE; SOME QUESTIONS AND ANSWERS, in *Aerospace Engineering*, v. 21, no. 9 (Sept 1962) 16–23, and in *The General Electric Forum* (July–Sept 1962).

A panel discussion with the following participants: D. Brainerd Holmes, Robert R. Gilruth, Walter C. Williams, Dr. Wernher von Braun, Alan B. Shepard, Paul Haney, and Lt. Col. John Powers. The "why's" and the "wherefore's" of expending upward of $200 billion to place a MAN on the Moon are explored, as well as the reason for sending man instead of an instruments package.

MAPS FOR LUNAR EXPLORATION, by Maj. William B. Taylor, in *The Military Engineer*, v. 55, no. 364 (Mar-Apr 1963) 86–88.

After RANGER, the SURVEYOR program should provide higher resolution imagery of selected lunar sites. And, if present plans materialize, an unmanned lunar orbiter will produce high resolution coverage of lunar regions of interest to APOLLO. Finally, the manned, orbiting APOLLO mother ship might carry precision cameras and bring back high-quality photographs of both sides of the Moon. Such photographs would permit more precise photogrammetric data reduction and the production of true lunar maps in the classical sense. The US lunar program is now a full-scale project. Plans are under way for orbiting the additional data needed for the production of larger-scale, accurate lunar maps.

THE MOON, by A. G. W. Cameron, in *International Science and Technology*, no. 5 (May 1962) 24–32,

A large body of knowledge about the Moon still leaves some vital questions unanswered. Lunar probes measuring radioactive levels, surface composition and seismic activity will answer some—but not all. The author reviews the various conflicting pictures of the Moon presented by different kinds of evidence.

THE MOON, GATEWAY TO SPACE, by Comdr. Albert J. Kelley, in *Sperryscope*, v. 15, no. 12 (First Quarter 1962) 20–24.

The importance of the Moon, routes to the Moon, role of man, research and technology, space applications, and why a space program.

MOON MAY NOW BE CONTAMINATED, by William Beller, in *Missiles and Rockets*, v. 11, no. 9 (27 Aug 1962) 24–27.

Man may have already contaminated the Moon through the impact landings of LUNIK II and RANGER IV, possibly "killing" man's hope to explore a virgin Moon.

ONE-MAN, ONE-WAY MOON TRIP URGED, by Willard E. Wilks, in *Missiles and Rockets*, v. 10, no. 26 (25 June 1962) 16–17.

A program for sending a US astronaut on a one-way trip to the Moon, as presented at the recent summer meeting of the Institute of Aerospace Sciences. Proposal details and program weaknesses are discussed.

THE ONE-WAY MANNED SPACE MISSION, by John M. Cord and Leonard M. Seale, in *Aerospace Engineering*, v. 21, no. 12 (Dec 1962) 60–61 plus.

The One-Way Manned Space Mission consists of sending a man to the Moon or a planet without propulsion to return him to Earth. The paper presents a scientific and technical evaluatin of a One-Way Manned Lunar Mission including a summary of lunar environments, life support requirements, propulsion, vehicle design, and weights, base and logistics requirements.

ORBITAL ASSEMBLY AND LAUNCH FOR LUNAR OPERATIONS, by Norman V. Petersen, in *Aerospace Engineering*, v. 21, no. 8 (Aug 1962) 41–57.

General mission requirements for an Earth-orbital assembly and launch system to accomplish manned lunar operations are presented. A concept for development, general system characteristics, and operational use of a proposed orbital launch pad for rendezvous, assembly, check-out and launch of manned lunar flyby, orbiting and landing vehicles are discussed. Particular emphasis is given to utilization of rendezvous compatible orbits and stationkeeping for improved surface-to-orbit launch logistics. The "best route to the Moon," employing a proposed Space Canaveral facility as a low-altitude orbital assembly and launch adjunct to Cape Canaveral, will significantly increase the United States' capacity for lunar and interplanetary exploration.

ORTHOGRAPHIC ATLAS OF THE MOON. SUPPLEMENT NUMBER ONE TO THE PHOTOGRAPHIC LUNAR ATLAS, comp. by D. W. G. Arthur and E. A. Whitaker, and ed. by Gerard P. Kuiper. Tucson, University of Arizona, 1962. np.

This supplement was produced with the technical assistance of the Air Force Aeronautical Chart and Information Center and is Edition A showing the standard orthographic Coordinate Grid. The chief purpose of this Atlas is to provide a precision lunar map that combines (1) the best photography now available; (2) the coordinate system defined by aggregate of the roughly 5,000 position measures. See also

PHOTOGRAPHIC LUNAR ATLAS, ed. by Gerard P. Kuiper. Chicago, University of Chicago Press, 1962. np.

PHYSICS AND ASTRONOMY OF THE MOON, ed. by Zdendk Kopal. New York, Academic Press, 1962. 538 p.

The motion of the Moon is space; liberation of the Moon; dynamics of the Earth-Moon system; photometry of the Moon; the polarization of moonlight; lunar eclipses; topography of the Moon; interpretation of lunar craters; physical observations of lunar surfaces; the luminescence of the lunar surface; temperatures on the lunar surface; radio echo studies of the Moon; origin and history of the Moon. References. Illustrated.

U.S. STEPS UP PLANNING FOR MOON, by William Beller, in *Missiles and Rockets*, v. 10, no. 25 (18 June 1962) 23–25.

How lunar environment, base construction, and mapping are being studied with an eye to a multibillion-dollar exploration. NASA plans for a Moon base, military on the Moon, lunar research program, using balloons and rockets, using simulators and theory, and the Army and the Moon.

U.S. TO SELECT ORBITING LAB OR LUNAR BASE, by Edward H. Kolcum, in *Aviation Week and Space Technology*, v. 78, no. 7 (18 Feb 1963) 32–34.

US will decide within the next year whether a permanent orbiting laboratory or a lunar station will be the next manned space flight program. The decision will be based primarily on the results of a series of studies being conducted by NASA and industry. Whichever program is selected will entail companion projects in launch vehicles and supply and re-supply spacecraft. Primary emphasis of the studies is on lunar logistics systems, lunar bases, space stations, and manned planetary missions. Two configurations have emerged from logistic system studies: lunar excursion module modification known as the LEM truck, in which concept the ascent engine would be replaced by a cargo platform and a payload of 5,000–6,500 lbs. could be landed; logistics spacecraft launched directly to the Moon by a SATURN 5 vehicle, which could provide a payload of 25,000–30,000 lbs.

WHY LUNAR-ORBIT RENDEZVOUS, by D. Brainerd Holmes in *Astronautics*, v. 7, no. 11 (Nov 1962) 24–28.

Selection of a salient approach for an early manned lunar landing requires an important managerial state-of-the-art evaluation. This report presents such an evaluation, which stresses the advantages of the lunar-orbit-rendezvous mode.

2. Mars, Venus, and Other Planets.

THE ATMOSPHERES OF MARS AND VENUS, by William W. Kellogg and Carl Sagan. Washington, National Academy of Sciences, National Research Council, 1961. 151 p. (Publication 944.)

A report by the Ad Hoc Panel on Planetary Atmospheres of the Space Science Board (of the National Academy of Sciences). A conference on Planetary Atmospheres, with special reference to Mars and Venus, was held by the Space Board of the National Academy of Sciences on June 24, 1960, at Arcadia, California. The purpose of the conference was to discuss the present state of knowledge of planetary atmospheres as known from ground-based observations, to consider the most important characteristics about which additional information is needed, and to discuss space experiments that best promise to yield such information . . . . A capability for launching heavy payloads of scientific equipment to investigate other planets of our solar system can be anticipated within the next few years. It is to be expected that the initial investigations of these planets will involve direct measurements of their atmospheres, even before scientific apparatus is landed on their surfaces .... In view of the importance of the subject, and as a sequel to its Arcadia conference, the Board appointed an Ad Hoc Panel on Planetary Atmosphere to study, in greater detail, the state of our knowledge and some of the controversies concerning planetary atmospheres and to explore experimental approaches most likely to lead to the resolution of these controversies. This is the report of that Panel.

FEASIBILITY OF INTERSTELLAR TRAVEL, by Dwain F. Spencer and Leonard D. Jaffe. Pasadena, California Institute of

Technology, March 1962. 17 p. (Technical Report No. 32–233.)

The feasibility of interstellar flight is discussed. Mathematical equations for single-stage and multistage rocket propulsion are developed; velocity data and transit times are presented. The conclusions indicate that interstellar travel is theoretically feasible by utilizing known staged nuclear-energy systems.

A LIFE COLONY FOR MARTIAN EXPLORATION, by F. H. Bellamy and D. A. Wigley, in *Spaceflight*, v. 5, no. 2 (Mar 1963) 38–45.

In 1959 the Derby sub-branch of the British Interplanetary Society organized an exhibition, for which a number of models were produced, including one of a permanent life-colony on Mars. From the many questions the members of the sub-branch asked themselves, in preparation of the model, and those which were put to them during the exhibition, it became obvious to them that there was scope for a study as follows: to assemble, in more detail, the information already available in the requirements for man to exist on Mars; also to consider some of the points in a more speculative way, assuming that by the time of the first expedition technical progress would have made feasible solutions which currently are no higher than possibilities. This paper attempts to set out briefly those aspects on which there was substantial agreement by a small group of the Derby members. Basic assumptions, the journey, and living on Mars (the atmosphere, the "weather," the surface, choice of site, construction of the colony, power, workshops, living quarters, space medicine, food production, transportation and exploration, communications, et cetera).

MANNED VENUS, JUPITER SATELLITES PLANNED, by Edward H. Kolcum, in *Aviation Week and Space Technology*, v. 77, no. 20 (12 Nov 1962) 26–28.

Manned satellites of the planets Jupiter and Venus are part of the US long-range space exploration plan, which was outlined by NASA in Chicago at the NASA-University Conference on space science and technology. NASA's long-range timetable includes stations on the Moon and Mars. US to search for life on other planets. Includes chart showing long-range US space exploration plan.

A PHOTOGRAPHIC HISTORY OF MARS, 1905–1961, by Earl C. Slipher. Lowell Observatory, 1962. 168 p.

"The purpose of this book is to provide the most complete and best available coverage of the Planet Mars as a contribution of the United States Government in the national space effort." This publication was produced under Air Force Cambridge Research Laboratory Contract No. AF 19(604)–5874 and publication was sponsored by the USAF Aeronautical Chart and Information Center under Contract No. AF 23 (601)–3602. Coordination with the scientific community was established through Commission No. 16 "Physical Studies of Planets and Satellites: of the International Astronomical Union."

VENUS MISSION—1962, by Robert C. Wyckoff, in *Astronautics*, v. 7, no. 7 (July 1962) 54–59.

A review of the first of a series of flights of scientifically instrumented spacecraft to the planet VENUS. The mission had three primary objectives: launching a spacecraft to the vicinity of Venus, communication with the spacecraft in the vicinity of this planet, and performing a Venus-oriented scientific experiment and others oriented toward interplanetary space. With a short list of references.

D. Space Communications.

COMMUNICATION WITH EXTRATERRESTRIAL INTELLIGENCE, by Paul Rosenberg, in *Aerospace Engineering*, v. 21, no. 8 (Aug. 1962) 68–69 plus.

"A small but expanding group in the scientific community is studying and actually planning to search for evidence of communication from extraterrestrial life by radio telescope and similar means; but the subject is still regarded with distrust by some scientists in the aerospace field who demonstrate [what some call] . . . . the 'resistance to scientific discovery!' This resistance is due, at least in part, to lack of acquaintaince with the subject, and this paper is a small attempt to help fill this lack."

EARTH-SPACE TELECOMMUNICATION OF THE FUTURE, by S. G. Lutz, in *Signal*, v. 17, no. 5 (Jan 1963) 29–32.

This paper hazards a forecast concerning earth-space telecommunication systems of the future, and examines features and possible problems of such far-future systems. Included are such areas as physical limitations and costs.

THE NEW ERA OF COMMUNICATIONS: EARTH-SPACE COMMUNICATIONS, in *Space/Aeronautics*, v. 38, no. 6, part 2 (Nov 1962) 35–36 plus.

A general survey of the present situation in, and the outlook for, communications with spacecraft, covering usable frequencies antennas, ground and spaceborne receivers and transmitters, and telemetry, command and control, tracking, voice, and video links.

NEW PROBLEMS OF SPACE COMMUNICATIONS, by Solomon W. Golomb, in *Astronautics*, v. 7, no. 6 (June 1962) 19, no. 7 (July 1962) 19, no. 8 (Aug 1962) 26.

This series of articles indicated some of the "many surprising aspects" of space communication. The author hopes that in due course the unexpected will become commonplace and that more creative thought will be directed toward the formulation as well as the resolution of the bizarre but very real problems of our technological age.

SPACE COMMUNICATIONS; STATE OF THE ART, by George V. Kedrowsky, in *Space/Aeronautics*, v. 33, no. 4 (Apr 1962) 127 plus.

With orders-of-magnitude improvements, the present state of the art can be extended to achieve reliable communications within our solar system. This article shows intergalactic communications, on the other hand, "so far looks simply impractical." Besides broadly assessing the current state of space communications, this article reviews the basic design parameters of this field, showing in particular how they affect the choice of operating frequency. Methods for extending range, the problems of noise, and the different types of links involved in space communications are also discussed.

SPACECRAFT COMMUNICATIONS SYSTEMS, by R. K. Keenan and H. R. Mannes, in *Space/Aeronautics*, v. 38, no. 6, part 2 (Nov 1962) 23–29.

Reports on the spacecraft communications system designers' progress in meeting the challenges of distance and vehicle constraints. Discusses extension of the solid state art, efficient modulation and demodulation, coding, signal processing and enhancement techniques, and power-bandwidth tradeoffs.

THE STORY OF ADVANCED COMMUNICATIONS: DISTANCE, DIGITS, DATA, by James Holahan, in *Space/Aeronautics*, v. 38, no. 6, part 2 (Nov 1962) 6–17.

A survey of the current state of the art in advanced communications and the outlook for future developments, with particular emphasis on communications satellites, spacecraft communications, digital modulation, digital TV, digital voice, coding, computer-controlled communications, and data communications.

U.S. DRAFTING SPACE FREQUENCY PROPOSAL, by Katherine Johnsen, in *Aviation Week and Space Technology*, v. 77, no. 23 (3 Dec 1962) 36–37.

"U.S. is launching a drive to win international support for radio frequency allocations needed for operational meteorological, navigational, and communication satellite systems and for its APOLLO lunar landing program and other space research projects. A draft of U.S. proposals has been distributed by Federal Communications Commission for final review by government and private domestic frequency users and equipment manufacturers." The proposals will be formally presented to a special conference of the International Telecommunication Union—the Extraordinary Administrative Radio Conference for Space Radiocommunication—scheduled to convene next fall in Geneva to allocate frequencies for space activities.

THE WORK OF THE CCIR IN THE FIELD OF SPACE COMMUNICATIONS, by I. Ranzi, in *Signal*, v. 17, no. 1 (Sept 1962) 19–21 plus.

The International Radio Consultative Committee's Study Group IV of Space Communications held its first meeting in Washington from 12 to 23 Mar. 1962. It was an interim meeting to prepare the Plenary Assembly of the CCIR scheduled for New Delhi in Jan., 1963. A series

of documents was arranged concerning questions, study programs, reports and recommendations in draft, to be submitted to the Plenary Assembly for its final approval. A list of discussed subjects is presented by the author, with some summarizations of conclusions: factors affecting the selection of frequencies for telecommunication with and between space vehicles; technical characteristics of communication systems using Earth satellites as active or passive repeaters; technical characteristics of Earth-space links; space service antennae; sharing of the radio-frequency spectrum with other services; protection of frequencies used for radio-astronomical measurements; experimental communication satellite program in the US; and preliminary views of USSR on frequency allocation for space services.

E. Space Exploration—International Aspects and Implications.

COOPERATIVE SATELLITE PROGRAMS TO BE DISCUSSED BY U.S., USSR, by Cecil Brownlow, in *Space Technology International*, v. 5, no. 3 (July 1962) 32–33.

"Potential broadening of initial arrangements for cooperation in peaceful space ventures, agreed upon by U.S. and Soviet delegates in recent bilateral negotiations . . ., will be discussed at a proposed follow-on meeting in the near future. A major item to be covered in talks between representatives of the two countries is the field of communications satellites."

INTERNATIONAL COOPERATION IN SPACE RESEARCH, by Arnold W. Frutkin, in *Astronautics and Aerospace Engineering*, v. 1, no. 2 (Mar 1963) 100–106.

How "despite formidable problems, both national policy and unifying forces of massive technologies of the future move nations into and toward new relationships for space research and operations."

THE INTERNATIONAL INSTITUTE OF SPACE LAW, by Robert D. Crane, in *Spacecraft*, v. 4, no. 3 (May 1962) 89–99.

The establishment of the International Institute of Space Law in 1959 represented the culmination of almost a decade of work by predecessor organizations within the International Astronautical Federation. Describes: the genesis of the work on space law as performed by the Federation; development of space communications law; institutional development of international space law; et cetera. Includes statutes of the International Institute of Space Law of the International Astronautical Federation.

INTERNATIONAL POLITICAL IMPLICATIONS OF ACTIVITIES IN OUTER SPACE. A REPORT ON A CONFERENCE OCTOBER 22–23, 1959, by Joseph M. Goldsen. Santa Monica, California, Rand Corporation, May 5, 1960. 280 p. (Report R–372–RC.)

This report is in two parts: Part I is a transcript of a two-day conference on "International Political Implications of Activities in Outer Space," held in Washington, D. C. Part II consists of papers prepared especially for the conference by four of the participants; PUBLIC OPINION AND THE DEVELOPMENT OF SPACE TECHNOLOGY, by Gabriel A. Almond; ON THE INTERNATIONAL IMPLICATIONS OF OUTER SPACE ACTIVITIES, by Klaus Knorr; ON OUTER SPACE AND INTERNATIONAL POLITICS, by Karl W. Deutsch; THE NATURAL HISTORY OF MAN'S EMERGENCE INTO SPACE, by Louis J. Halle. The agenda of the proceedings of the conference included, among others, the following two topics: 1. MILITARY USE OF OUTER SPACE: BOMBARDMENT SATELLITES; 2. SOVIET AND AMERICAN COLD-WAR OBJECTIVES, ACTIONS, POLITICAL EXPLOITATION OF "SPACE": a. Diplomacy, b. International Law, c. Propaganda, d. United Nations, e. International Science (e.g. IGY, COSPAR, ICSU).

THE SCIENTIFIC NECESSITY FOR A ROCKET NETWORK IN EUROPE, by Heinrich Faust, in *British Interplanetary Society, Journal*, v. 18, no. 8 (Mar–Apr 1962) 306–309.

There are many reasons for a world-wide sounding rocket network, most of them of a meteorological nature. Large-scale weather research would benefit most from the establishment of such a network. The advantages of an extension of the North American network to the European area are discussed with the aid of data being obtained in the author's research project by evaluation of sounding rocket results.

The SPACE RACE: FROM SPUTNIK TO APOLLO AND BEYOND, by Donald W. Cox. Philadelphia, Chilton, 1962. 393p. (Forwarded by the Honorable J. W. Fulbright, Chairman of the U.S. Senate Committee on Foreign Relations.)

"This covers the major cosmic-shaking events of the critical past half-decade with a survey of the reasons why the United States continues to lag behind the Soviets in achieving notable firsts in space." The book contains many references on US Army, Navy, and Air Force programs. In seeking a way to thwart the Communist dreams of control of the cosmos, the author offers a long-range 40-year grand assault on space, cooperating with the Soviets through the United Nations. Appended: a graph showing USSR-US space race 4 October 1957—January 1963: also Space Race Timetable for the Cosmic Sixties (US-USSR) 1962 to 1969.

TREATIES IN FORCE; A LIST OF TREATIES AND OTHER INTERNATIONAL AGREEMENTS OF THE UNITED STATES IN FORCE ON JANUARY 1, 1962. Washington, Department of State, 1962. 308 p. (Publication 7327.)

UN WEATHER SATELLITE NET PLANNED, in *Missiles and Rockets*, v. 10, no. 25 (18 June 1962) 14.

A ten-year plan for development of a world-wide system of weather reporting based on meteorological satellites has been agreed to by representatives of the US and the Soviet Union. The plan is outlined.

U.S. DRAFTING SPACE FREQUENCY PROPOSAL, by Katherine Johnsen, in *Aviation Week and Space Technology*, v. 77, no. 23 (3 Dec 1962) 36–37.

"U. S. is launching a drive to win international support for radio frequency allocations needed for operational meteorological, navigational, and communication satellite systems and for its APOLLO lunar landing program and other space research projects. A draft of U.S. proposals has been distributed by Federal Communications Commission for final review by government and private domestic frequency users and equipment manufactures." The proposals will be formally presented to a special conference of the International Telecommunication Union—the Extraordinary Administrative Radio Conference for Space Radiocommunication—scheduled to convene next fall in Geneva to allocate frequencies for space activities.

U.S. PARTICIPATION IN THE U.N. REPORT BY THE PRESIDENT TO THE CONGRESS FOR THE YEAR 1961. Washington, Government Printing Office, 1962. 414 p. (Department of State Publication 7413.)

The efforts of the United States during 1961, to strengthen the U.N. role with respect to outer space and to encourage the development of international cooperation in outer space matters through the United Nations, will be found on pages 39–43 of this Report.

U.S. / RUSSIA — CRITICAL STAGE IN SPACE TALKS, by William Beller, in *Missiles and Rockets*, v. 10, no. 18 (30 Apr 1962) 12–13.

US-USSR efforts to cooperate in space are reaching the critical stage, but top American officials continue to express guarded optimism over the chances for a limited agreement. Scientists on both sides agree to the formation of a joint "Weather Watch." The article points out that the US is willing and that there is a role for all, and discusses the USSR's new stand and the basis for understanding.

U.S., U.S.S.R. APPROVE JOINT SPACE TASKS, by Ward Wright, in *Aviation and Space Technology*, v. 77, no. 24 (10 Dec 1962) 30–31.

The US and USSR governments have formally approved the following three joint programs for the peaceful uses of outer space: meteorological research to be conducted in two phases; world geomagnetic survey to take place during the period of the International Year of the Quiet Sun (IYOS).

F. Space Satellites: Applications.

1. Miscellaneous Aspects.

IMP SOLAR FLARE DATA MAY SAVE LIVES OF ASTRONAUTS, by William Beller, in *Missiles and Rockets*, v. 10, no. 17 (23 Apr 1962) 32–33.

Satellites developed by NASA's Goddard group will also investigate Earth-Sun relation-

ships. The lives of some future APOLLO astronauts may depend on how successfully a newly disclosed monitoring satellite called IMP (Interplanetary Monitoring Probe) gathers data from cislunar space. On the lookout for proton and other solar radiations, an IMP is intended to be in orbit at all times—starting from the scheduled first launch in the second quarter of 1963. A prime purpose of IMP is to help develop a way to anticipate solar flares.

IS SATELLITE DEFENSE FEASIBLE? by Charles Stuart, in *Space/Aeronautics*, v. 38, no. 1 (July 1962) 58–60.

The feasibility of defense against various forms of space and air attack by putting up satellite systems can be analyzed, this article shows, with help of simple statistical models based on classical mechanics and probability theory. Such analyses are presented for satellite defense against ICBM's, satellites, and aircraft. The results show that, while ICBM attack heavily forms the offense, the crucial total weight requirement is remarkably low for the other two forms of satellite defense.

NAVIGATION SYSTEMS FOR AIRCRAFT AND SPACE VEHICLES, ed. by T. G. Thorne. Oxford, Pergamon Press, 1962. 550 p.

Papers presented at the AGARD (Advisory Group for Aeronautical Research and Development, North Atlantic Treaty Organization) Avionics Panel Meeting 3–8 October 1960, Istanbul. Part C—pp. 445 to 537 deals with navigation in space and navigation on earth using satellites. Photos and other illustrations.

SPACE OBSERVATIONS OF SUN AND EARTH, in *Sky and Telescope*, v. 23, no. 5 (May 1962) 256–259.

"The Sun is now being observed by a complex 450-pound artificial satellite that was launched from Cape Canaveral on March 7th by a three-stage DELTA vehicle. The orbiting solar observatory (OSO) moves in a nearly circular track some 350 miles above the Earth's surface. It is the first in a series of satellites intended to study the Sun throughout an entire 11-year sunspot cycle, and carries an array of 13 experiments to measure solar radiation at ultraviolet, X-ray, and gamma-ray wavelengths." Touches also on: the major sections of OSO; the latest TIROS; and the Soviet launchings of COSMOS I and COSMOS II.

2. Charting and Mapping.

ARMY SATELLITES TO ENHANCE MAPPING, by James Trainor, in *Missiles and Rockets*, v. 11, no. 25 (17 Dec 1962) 16–17.

The Army Corps of Engineers is developing two inexpensive piggyback satellites (cheaper than ANNA) as part of a three-to-five-year program to tie existing geodetic datum planes into a single world-wide network. Using the 20-in-dia. VANGUARD shell and the SECOR (Sequential Collation of Range) radio-ranging unit, the "TYPE I" geodetic satellite was evolved. With the TYPE I vehicle, the geodetic satellite could be launched as part of a composite payload. Also discusses: the next step, "TYPE II"; what SECOR IS; and the ground equipment.

S–66 WILL CHART THE IONOSPHERE, by William Beller, in *Missiles and Rockets*, v. 11, no. 6 (6 Aug 1962) 22–24.

How the first major step toward a global map of the ionosphere is scheduled for early next year when the S–66 Polar Beacon Ionosphere Satellite goes into orbit. Discusses: the low cost of the project, its history, the scientific goals, radio transmissions, Laser tracking, structure, attitude control, et cetera.

3. Space Communication Satellites.

COMMUNICATION BY SATELLITE, by Leonard Jaffe, in *International Science and Technology*, no. 8 (Aug 1962) 44–51.

The author examines the decisions and technical "trade-offs" it takes to set up a world-wide satellite communication system.

COMMUNICATIONS SATELLITES; AN OVERVIEW, by Charles De Vore, in *Signal*, v. 17, no. 2 (Oct 1962) 35–38.

TELSTAR has been so successful that some may lose sight of the fact that it was intended only as an experiment, and represents only one approach toward a communications system that will have the required capacity for handling telephone and television channels on a global basis. The author discusses three major

communications satellite systems that are being actively investigated in the US: low or intermediate altitude passive reflectors, low or intermediate active repeaters, and high altitude synchronous, active repeaters. With sketches.

COMMUNICATIONS SATELLITES: TECHNOLOGY, ECONOMICS, AND SYSTEM CHOICES, by S. H. Reiger and others. Santa Monica, Calif., The Rand Corp., 1963. (Memorandum RM–3487–RC.)

The purpose of this study is to throw light on what may be "practicable" in terms of (1) communications satellite technology, (2) system costs, and (3) telecommunications demand and system revenues. One appendix deals with the military use of communication facilities.

COMPUTER-COMSAT NETWORK NEARER, by Michael Getler, in *Missiles and Rockets*, v.12 , no. 1 (7 Jan 1963) 38–39.

Communication satellites with high-quality TV links should play a major role in development of very rapid and economical long-range computer-communications networks for industry. A significant early step toward integrating high-speed, high-capacity computer systems with common-carrier communication lines came in Dec. 1962 when IBM scientists transmitted data at 20 million bits/sec. over a single high-quality TV channel in an experimental 40-mile closed-loop ground system.

[EXPERIMENTAL COMMUNICATIONS SATELLITES], in *Interavia*, v. 17, no. 6 (June 1962) 749–766.

This survey of communications satellites consists of the following articles: SITUATION REPORT ON COMMUNICATIONS SATELLITES (including charts of satellites already launched or under development and proposals for new ones); SATELLITE COMMUNICATIONS AND FREQUENCY SHARING, by Samuel G. Lutz; DEVELOPMENT OF THE RELAY COMMUNICATIONS SATELLITE; TELSTAR — THE PRIVATE VENTURE SATELLITE; THE ADVENT STATIONARY COMMUNICATIONS RELAY SATELLITE (a military program with commercial implications); THE BRITISH SPACE DEVELOPMENT COMPANY, by Gp. Capt. E. Fennessy (its proposals for a British Commonwealth Satellite Communication System).

FOREIGN PARTICIPATION IN COMMUNICATIONS SATELLITE SYSTEMS: IMPLICATIONS OF THE COMMUNICATIONS SATELLITE ACT OF 1962, by Murray L. Schwartz and Joseph M. Goldsen. Santa Monica, Calif., The Rand Corp., 1963. (Memorandum RM–3484–RC.)

This study discusses some of the international political implications of communications satellites systems. The factors of alternative technologies, of systems costs and prospective economic demand for international communications facilities are not dealt with here. Includes test of the Communications Satellite Act of 1962.

MILITARY COMMUNICATIONS SATELLITES, by Brig. Gen. William M. Thames, in *Signal*, v. 16, no. 10 (June 1962) 40–43.

Today's answer to tomorrow's communications needs lie more and more in space, in establishing the capability of transmitting messages over intercontinental distances through artificial satellites. Project ADVENT is believed to be the world's most advanced experimental effort "directed toward hastening such a revolutionary concept into reality." The author discusses: passive and active satellites; high and low altitude systems; satellite program history beginning with Project DIANA, Project SCORE, et cetera; the ADVENT program; and experimental ground terminals.

NAVY SATELLITE COMMUNICATIONS, by Lt. Comdr. Burton I. Edelson and Comdr. John J. Dougherty, in *U.S. Naval Institute Proceedings*, v. 88, no. 7 (July 1962) 65–75.

One of the first big dividends from the US space effort will occur in satellite communications. "Of the many areas in which our national space program is engaged, none promises more in utility to mankind in general. Communications by satellite relay offer a great and quick hope for political, technological, and economic gain." The authors discuss: communication satellite possibilities, types of communication satellites, Navy communication requirements, Navy satellite communications program, the Communications Moon Relay System, the ADVENT satellite communications ship, VLF (very low frequency) satellites, et cetera.

SATELLITE COMMUNICATIONS LINKS, by S. A. W. Jolliffe and W. L. Wright, in *Point to Point Telecommunications*, v. 6, no. 3 (June 1962) 6–29.

"Satellite systems are likely to become a new medium for long-distance communication. Many new factors are involved in establishing new inter-continental networks, and this article reviews some of the important aspects of satellite communications."

SATELLITES FOR AREA COMMUNICATIONS, by George E. Mueller, in *Astronautics and Aerospace Engineering*, v. 1, no. 2 (Mar 1963) 66–69.

How area-communications satellites with narrow-beam antennas up to 40 ft. in diam. could provide TV links between the US and emerging nations of Asia and Africa, and improved military communications.

SATELLITES LOOK BEST FOR COMMUNICATIONS ON THE MOON, by Joseph P. Ferrara, in *Space/Aeronautics*, v. 38, no. 4 (Sept 1962) 75–79.

Passive or active satellites appear to offer the greatest promise for long-range communications on the moon, this article shows in a review of the factors involved in such communications, including orbit parameters. Lunar equatorial satellites are useful within a latitude band of ± 50 deg. The minimum number of satellites for continuous equatorial coverage varies from ten at altitudes of 50nm to three at 1,000 nm. Although a three-satellites array is satisfactory for stations along the equator, additional satellites must be orbited to decrease dead-zone areas at latitudes greater than ± 10 deg. In certain cases, polar satellites improve the coverage.

A STUDY OF PASSIVE COMMUNICATION SATELLITES, by S. H. Reiger. Santa Monica, Calif., The Rand Corp., 1963. 206 p. (R–415–NASA.)

A report prepared for NASA—NASr–21(02). This report deals with communication systems that use radio signals reflected from artificial earth satellites. Four main problem areas are examined in the study: (1) the technical parameters that determine the capability of a communication link when a satellite is mutually visible from a pair of terminals; (2) the orbital configuration of the satellites and its effect on satellite visibility and continuity of service; (3) significant systems tradeoffs and their influence on systems cost; and (4) comparison with systems using active repeaters.

TELSTAR: COMMUNICATION BREAKTHROUGH BY SATELLITE, by Louis Solomon. New York, McGraw-Hill, 1962. 62 p.

In text and photos the story of TELSTAR. Also an outline of what is scheduled in the field of satellite communicating systems (e.g. SYNCOM).

THE TELSTAR SATELLITE—EXPLORING THE UNKNOWN IN WORLD-WIDE COMMUNICATIONS, in *Signal*, v. 16, no. 2 (Aug 1962) 57–60 plus.

A panel by American Telephone and Telegraph Co. and NASA at the 1962 convention of the Armed Forces Communications and Electronics Association: OBJECTIVES OF TELSTAR—EXPERIMENT AND APPROACH TO BE TAKEN; NASA'S PARTICIPATION IN TELSTAR; THE TELSTAR SATELLITE; GROUND STATIONS FOR TELSTAR EXPERIMENT.

TELSTAR: TOWARD LONG-TERM COMMUNICATIONS SATELLITES, by James Holahan, in *Space/Aeronautics*, v. 37, no. 5 (May 1962) 64–69.

Reviews the schedule for launchings of the TELSTAR communications satellites and the results "they are expected to achieve." Analyzes the design of the satellite, giving details on the communications package, telemetry and command, power supply, and stabilization systems, on the TELSTAR radiation experiments, and on reliability procedures used in component selection.

TV BROADCASTING FROM SATELLITES, by N. I. Korman, in *Signal*, v. 16, no. 9 (May 1962) 10–11 plus.

How Radio Corporation of America has been studying the feasibility of relaying television through a satellite directly into home receivers. A first demonstration could occur in

the middle of this decade and full operational service could be achieved by the end of this decade. RCA believes that a synchronous satellite would be best for this service. The author also discusses satellite power supply and launch system, and the need to broadcast via satellite.

TV BROADCASTING FROM SATELLITES, by George M. Ives, in *Astronautics*, v. 7, no. 6 (June 1962) 86–88.

How many economic and technical factors temper planning systems for television broadcasting from satellites.

VELOCITY REQUIREMENTS FOR THE CORRECTION OF A 24-HOUR ORBIT, by J. H. Hutcheson. Santa Monica, California, Rand Corporation, March 1962. 32 p. (RM–3045–NASA.)

This study was conducted under NASA Contract NASr–21(02), monitored by the Office of Space Flight Programs, and is one of a series of research memoranda dealing with control processes associated with the operation of a 24-hour communication satellite. The principal objective of this investigation is the determination of the relationship between fuel requirements and useful lifetime in orbit for a specified payload or payloads. The investigation includes studies of methods for achieving satisfactory orbital and attitude control.

G. Space Stations and Aerospace Planes.

1. Rendezvous in Space.

ORBITAL RENDEZVOUS AND ASSEMBLY, by N. V. Peterson and others, in *Space/Aeronautics*, v. 37, no. 6 (June 1962) 57–63.

With NASA's decision in favor of orbital launch for the APOLLO Moon flights, orbital assembly has once and for all progressed beyond the realm of pure speculation. This article outlines a series of techniques that make orbital assembly clearly feasible. Treating orbital assembly as a matter of coupling complete "modules" in space, it describes favorable guidance techniques for the early and final phases of rendezvous, analyzes for docking and coupling mechanisms, and reviews the configurations for orbital-base and mission systems. In addition, it outlines the general requirements that must be met by the hardware designs for these systems.

RENDEZVOUS IN SPACE, by Martin Caidin. New York, Dutton, 1962. 320 p.

The story of projects MERCURY, GEMINI, DYNA-SOAR and APOLLO. Many photos, drawings, and diagrams. Includes information of VOSTOK I and VOSTOK II spaceships and the Soviet astronauts Yuri Gagarin and Gherman Titov.

2. Aerospace Planes.

AEROSPACE PLANE: ANSWER TO ROCKETING COSTS, by J. S. Butz, Jr., in *Air Force*, v. 45, no. 5 (May 1962) 42–43 plus.

Nonrecoverable rocket boost systems are inevitably going to prove too expensive for purposeful, economical, sustained space missions. The time is short to start intensive efforts to prove feasibility of a manned craft that can take off conventionally, propel itself into orbit, and be flown home for controlled landings.

PRESENT TECHNOLOGY CAN HANDLE ADVANCED ASP NAVIGATION, by John F. Judge, in *Missiles and Rockets*, v. 10, no. 24 (11 June 1962) 26–28.

The vehicle (advanced aerospace plane) and the propulsion packaged development is a far greater problem than the guidance and navigation requirements.

THE SPACE VEHICLE; MANNED VERSUS UNMANNED, by D. G. Starkey, in *Aerospace Engineering*, v. 21, no. 9 (Sept 1962) 88–89 plus.

Contrary to common belief in the controversy, man is not being pitted against a machine. Rather, the quandary is where best to utilize the human operator in the system loop. Complex mission objectives and increased operational flexibility and flight-time requirements point out the relative advantages of incorporating man as an on-board functional component having that "certain something" that is lacking in the nonhuman systems.

U.S. PLANS RESEARCH ASP IN '65, by Hal Taylor, in *Missiles and Rockets*, v. 10, no. 17 (23 Apr 1962) 12.

Joint AF-NASA program would be used to develop "aerospace" research plane in 1965 as a forerunner of future manned military spacecraft. The craft would be used to develop the technology for this country's post-1970 space exploration and military needs.

USAF, NASA PLANNING HYPERSONIC RESEARCH AIRCRAFT, by Edward H. Kolcum, in *Aviation Week and Space Technology*, v. 78, no. 6 (11 Feb 1963) 26–27.

Air Force and NASA have begun two-year analytical studies to determine what concepts and requirements will dictate design of the manned hypersonic aerospace research vehicle that will follow the X–20 A (DYNASOAR). The goal is to arrive at a national policy position by 1965 on whether the next generation aerospace research vehicle should be an air-breathing cruise vehicle, a single-stage-to-orbit Aerospace Plane, a combination of the two, or an entirely new concept.

3. Space Stations.

GOODYEAR SHOWS NEW INFLATABLE STATION, by Michael Getler, in *Missiles and Rockets*, v. 11, no. 7 (13 Aug 1962) 24.

A 30-ft.-diameter prototype of what is hoped will eventually expand into a funded program for an operational 150-ft. inflatable manned space station went on display recently at NASA's Lewis Research Center. NASA and military needs are still undefined in this area, however, there is a feeling that a decision may come in about a year.

[MANNED SPACE STATIONS], in *Astronautics*, v. 7, no. 9 (Sept 1962) 14–29 plus.

The following articles appear as a collection, reviewing various aspects concerning manned space stations: ROTATING MANNED SPACE STATIONS, by Paul R. Hill and Emanuel Schnitzer (How to prepare astronauts for lunar operations and deep-zone missions poses basic questions of space-station design.); AEMT SPACE-STATION DESIGN, by Rene A. Berglund (Evolved has been the base-point design of a 21-man station based on the automatically erectable modular torus.); DYNAMICS AND STABILIZATION OF THE ROTATING SPACE STATION, by Peter R. Kurzhals and James J. Adams (Its motions, feeling to the crew like the rolling of a ship, can be held to comfortable and safe limits by damping systems under study.); MATERIALS AND STRUCTURES FOR SPACE STATIONS, by Robert S. Osborne and others; ORBITAL STATION TEMPERATURE CONTROL, by Lenwood G. Clark and Kenneth A. Laband; and LIFE SUPPORT FOR SPACE STATIONS, by Dan C. Popma (The medium-duration missions of space stations—missions taking many weeks and involving large crews—will require reliable recycling systems for replenishing air and water.).

NAA [NORTH AMERICAN AVIATION] LAB UNVEILED AT IAS MEETING, by Hal Taylor, in *Missiles and Rockets*, v. 10, no. 19 (7 May 1962) 14–15.

It was announced at an Institute of the Aerospace Sciences meeting that a self-erecting manned orbiting laboratory may be the next major development in the US space program. A start on the laboratory, which might hold as many as 27 astronauts, "could be made within a year or so." This article reports on other interesting papers presented at the meeting, some of which dealt with solid propellant boosters, the advantages offered by POLARIS and MINUTEMAN, recovery of spacecraft, et cetera.

PSEUDO-GRAVITY SPACE STATION PROPOSED, by Warren C. Wetmore, in *Aviation Week and Space Technology*, v. 78, no. 4 (28 Jan 1963) 56–58.

The concept of a manned dumbbell-configuration space station, to be assembled in the 1967–69 period by multiple launches employing anticipated state-of-the-art booster technology in conjunction with rendezvous techniques, as detailed at the Jan. 1963 meeting in New York of the Institute of the Aerospace Sciences.

SELF-DEPLOYING SPACE STATION WILL SUPPORT EXPERIMENTS, FLIGHT PROCEDURES CHECKOUT, in *Aviation Week and Space Technology*, v. 77, no. 20 (12 Nov 1962) 56–57 plus.

"First step toward development of a manned Earth-orbiting platform will begin early next year with a request for proposals on a six-month detailed design study of a self-deploying space station." NASA was expected to issue its proposal request very early in 1963 for

the station which is planned to be operational by 1966 under joint sponsorship of NASA, as project manager, Defense Department, FCC, and the US Weather Bureau. Requests from scientific groups and universities in the US and abroad to conduct experiments and human factors investigations in the space station are expected to be so numerous that it is felt the project may grow into an international effort.

WANDERING WORLDS, by John W. Macvey, in *Air Force*, v. 45, no. 6 (June 1962) 68–69.

Planetoids—chunks of rock that circle the sun with the planets—travel paths that sometimes, astronomically speaking, veer close to the earth. Although the likelihood of collision is remote, "the possibility has fed the imaginations of science-fiction writers for years. Now it is possible to envision the use of planetoids as sites for cosmic observatories."

H. Upper Air and Space Research.

HI HOE AND THE FYH BOOSTER, in *Naval Research Reviews*, v. 16, no. 1 (Jan 1963) 1–5.

Navy scientists interested in studying the high atmosphere are considering the use of air-launched rockets to carry their experiments 1,000 miles or so above the earth.

METEOROLOGY — WHITHER THE WEATHER ROCKET? by Sherman W. Betts, in *Aerospace Engineering*, v. 22, no. 1 (Jan 1963) 210–212.

The development of the meteorological rocket appears to be stalling today somewhere in the vicinity of 50 to 70 km. above the Earth's surface. Over the last several years, military programs, gaining impetus from, and largely guided by support requirements for, the Service missile ranges, have developed the ARCAS and LOKI (or HASPO) meteorological systems to a point where they are now considered operational. The considerable stride that understanding of this atmospheric region might represent along the road to the ultimate goal of weather control justifies a mighty effort toward this development.

SOUNDING ROCKETS FOR ONLY $8 A SHOT, by William Beller, in *Missiles and Rockets*, v. 11, no. 7 (13 Aug 1962) 25.

A newly developed rocket which will take aerial photographs, telemeter data for weather profiles to 3200-ft. altitude, or gather atmospheric information useful for scientific studies —for only about eight dollars a flight. The data-acquisition version is called CRICKET; the weapon, BELLONA. The cold-propellant system also has potential for guerrilla warfare.

SOUNDING ROCKETS PROGRAM TO GET $10 MILLION FOR R & D, by William Beller, in *Missiles and Rockets*, v. 10, no. 14 (2 Apr 1962) 36–37.

NASA's Goddard Space Flight Center is working toward a family of probes that will be able to make cheap and simple vertical soundings in the territory beneath the lowest satellite. When these vehicles are devised, and their payloads are recoverable with regularity, then NASA will be ready more fully to explore and exploit a vast new field.

VI. SPACE AS A BATTLEFIELD

THE FANTASTIC WEAPONRY, by Philip Siekman, in *Fortune*, v. 65, no. 6 (June 1962) 156–159 plus.

"Space, as a theatre of operations, is already a reality. 'Eyes in the sky' are in orbit. Satellite missile may not be far behind. Military planners believe the US needs manned interceptors as much as it needs to go to the Moon."

IF SPACE BECOMES A BATTLEFIELD— WILL THE U.S. BE READY?" in *U.S. News and World Report*, v. 53, no. 10 (3 Sept 1962) 35–37.

"Space flights by the Soviet Union have suddenly put the spotlight on a new kind of war —armadas of nuclear dreadnaughts . . . . orbiting H-bombs . . . . space interceptors [and manned space bases]. Whole idea of war in space has moved from the realm of fantasy onto the drawing boards." This article is a report on the problem being considered by the U.S.: where U.S. and Russia stand on the military side of space exploration.

AN INTRODUCTION TO SPACE WARFARE, by M. Golovine, in *The Royal United Service Institution Journal*, v. 107, no. 628 (Nov 1962) 296–307.

This lecture broadly on the subject of astronautics and more precisely on its possible military applications. While the introductory part of the paper is in the nature of a technical summary, the second part, "dealing with the eventual development of orbital armaments, is a hypothesis," and the author submits certain ideas which have occurred to him in the course of studies made in this particular domain.

THE MILITARY CONTRIBUTIONS TO PROGRESS IN SPACE, by Gen. B. A. Schriever, in *Sperryscope,* v. 16, no. 3 (Fourth Quarter 1962) 2–5.

". . . . In an operational sense, space is simply an extended portion of our present area of military responsibility. Many of the strategic concepts that apply to operations in the atmosphere will also apply in space." After outlining the essential military contribution to the progress of space exploration, Gen. Schriever concludes that "In order to achieve success in our scientific endeavors, we must insure that access to space is guaranteed and that peace and freedom are preserved. Both the military and civilian aspects of our space program are vital, and both must be pursued with urgency. They share a common aim—the security and well being of the United States."

MILITARY IMPLICATIONS OF SPACE, by General Curtis E. LeMay, in *Vital Speeches,* v. 28, no. 15 (15 May 1962) 452–455.

The Chief of Staff, USAF, delivered this speech on March 28, 1962 at the Assumption College, Worcester, Massachusetts, and pointed out some of the steps that must be taken by the US to provide itself with capabilities in space if a fatal technological surprise is to be prevented in the 1970's.

THE MILITARY ROLE IN SPACE, by Brockway McMillan, in *Astronautics,* v. 7, no. 10 (Oct 1962) 18–21.

"Though we may hope that space will be used only for peaceful purposes, we cannot base our national security on hope alone. The resolution of this dilemma stands in three elements": continued full pursuit by the military of missions in space which are intrinsically peaceful and stabilizing; development by the military of the basic building blocks of further space capability as insurance against contingencies; and continued support of a broadly based national program in space technology. Thus, there is a military value to objects in space, and the successful accomplishment of clearly defined military missions will demand vehicles that are simple, reliable, commandable, and flexible.

MILITARY SPACE EFFORTS: THE EVOLUTIONARY APPROACH, by Maj. Gen. James F. Whisenand, in *Air Force,* v. 45, no. 5 (May 1962) 53–56.

"If, down the road a few years, we have another breakthrough in weaponry similar in significance to the thermonuclear breakthrough, the capability to operate in space may be decisive. If we have failed to develop this capability—and by accident or design the opposition has developed it—it may be too late for us to do anything about it. . . ."

SPACE DENIAL: COSTS AND CONSEQUENCES, by Clark C. Abt, in *Air Force,* v. 46, no. 3 (Mar 1963) 45–52 plus.

A close analysis of the ramification, risks, advantages, and disadvantages of US development of space-denial capability suggests that although political, military, and economic costs would be high, the possibility that the Soviets may attempt to deny space to us and/or deploy spaceborne bombardment systems which could upset the world strategic balance requires our serious efforts to create space-denial techniques. Our use of such capabilities would require great restraint in the face of varied risks involved in their deployment.

VII. ARMS CONTROL AND DISARMAMENT ASPECTS

THE ARMS CONTROL AND THE PROBLEM OF EVASION, by James K. Batten. Princeton, N. J., Princeton University, Center of International Studies, 1962. 28 p.

This monograph is based on a paper written by the author in a seminar on National Security Problems conducted by Thornton Read and Klaus Knorr at the Woodrow Wilson School of Public and International Affairs, Princeton University, in the Spring term of 1962. It is concerned with the problems of evasion and the motives that could prompt a nation to evade, as

well as with planning for evasion (clandestine deployment of ICBM's).

BREAKING THE COLD-WAR STALEMATE: A PROPOSAL, by Alton Frye, in *Air Force*, v. 45, no. 7 (July 1962) 53–55.

"The ultimate bar to peaceful cooperation or competition in space technology is the Soviet obsession with secrecy. Would a firm US resolve to deny the Soviets access to space—until they are willing to allow inspection of their vehicles to assure their peaceful missions—lead to true cooperation and contribute to viable arms control?" See also SPACE DENIAL—AN AMPLIFICATION, in *Air Force*, v. 45, no. 10 (Oct 1962) 54–56, in which Dr. Frye's suggestion that the US deny Soviet access to space, pending proof of the peacefulness of Soviet missions, has attracted much comment. Herewith are excerpts from two significant responses to Dr. Frye, and his replies.

THE SOVIET STAND ON DISARMAMENT. New York, Crosscurrents Press, 1962. 150 p.

A collection of nineteen basic Soviet documents on general and complete disarmament, the termination of nuclear weapons tests, and the relaxation of international tensions.

THE STRATEGY OF DISARMAMENT, by Henry W. Forbes. Washington, Public Affairs Press, 1962. 158 p.

This study attempts "to present an overall survey of recent disarmament trends and to establish as objectively as possible the chances for disarmament in the 1960's." Touches on vehicles, including missiles, of nuclear weapons.

THINKING ABOUT THE UNTHINKABLE, by Herman Kahn. New York, Horizon Press, 1962. 254 p.

Missiles and their employment figure prominently in this book since the author delves into the possible sizes and shapes of thermonuclear war and the various strategic concepts and types of deterrence and the politico-military implications arising in various types of scenarios which he proposes and analyses (e.g. Chapter Five: SCENARIO II: A MISSILE GAP RESULTS IN A CALCULATED AND CONTROLLED WAR).

UNITED STATES POLICY ON THE CONTROL OF OUTER SPACE, by Edmond C. Gouazé. College Park, Md., University of Maryland, 1962. 154 p. (Unpublished M. A. Thesis.)

Reviews what the United States has done by its policy program to ensure the orderly and peaceful use of outer space through a system of regulation and control by the international community. The chapters deal with need for control of outer space and the steps taken by the US unilaterally and through the UN. The study is concluded by a summary of past events, current developments bearing on the subject, and a look into the future. Bibliography.

VELA HOTEL SATELLITES IN FINAL HARDWARE STAGE, by Irwin Stambler, in *Space/Aeronautics*, v. 37, no. 6 (June 1962) 54–56.

"Of all the groping steps toward disarmament, a nuclear test ban is still the one most likely to succeed. It's mainly for this reason that there has been no slackening in the VELA program, despite the resumption of atomic testing." The author reviews the satellites around which VELA HOTEL will be built, the system for detecting nuclear explosions in outer space. It discusses the detection requirements of such surveillance, the detector designs that are being tried out, and the problem of interfering natural radiation that these detectors must overcome. The orbits to be used by the VELA HOTEL satellites also are covered.

VIII. CONGRESSIONAL HEARINGS AND DOCUMENTS

AEC EMERGES AS NEW SPACE AGENCY, by William Beller, in *Missiles and Rockets*, v. 11, no. 13 (24 Sept 1962) 14–15.

The Atomic Energy Commission emerges as a new space agency during hearings held Sept. 13, and 14, by a subcommittee of the Joint Committee on Atomic Energy. "This became evident when government witnesses testified that tentative agreement had been reached giving AEC responsibility for developing high-power nuclear-electric systems for space vehicles." First system involved is SNAP-50/SPUR, planned for operation early in 1970.

ANTITRUST PROBLEMS OF THE SPACE SATELLITE COMMUNICATIONS SYSTEM. HEARINGS BEFORE THE SUBCOMMITTEE ON ANTITRUST AND MONOPOLY OF THE COMMITTEE ON THE JUDICIARY, UNITED STATES SENATE, EIGHTY-SEVENTH CONGRESS, SECOND SESSION, PURSUANT TO S. RES. 258, PART 1—MARCH 29, 30, APRIL 4, AND 5, 1962; PART 2—APRIL 6, 10, 11, 12, AND 17, 1962. Washington, Government Printing Office, 1962. 2 pts.

Hearings on the anti-trust and monopoly problems involved in the establishment of the US segment of a worldwide communications system.

ASTRONAUTICAL AND AERONAUTICAL EVENTS OF 1962. House Committee on Science and Astronautics. Washington, Government Printing Office, 1963.

Prepared by NASA, with foreword by George L. Simpson. Several appendices include data on: satellites, space probes, and manned space flights for 1962; and chronology of major NASA launchings, 1962.

COMMUNICATION SATELLITES: TECHNICAL, ECONOMIC, AND INTERNATIONAL DEVELOPMENTS. STAFF REPORT PREPARED FOR THE USE OF THE COMMITTEE ON AERONAUTICAL AND SPACE SCIENCES UNITED STATES SENATE, EIGHTY-SEVENTH CONGRESS, SECOND SESSION, 25 FEBRUARY 1962. Washington, Government Printing Office, 1962. 287 p. (Committee Print.)

This report is a follow-on to two earlier staff reports published by the committee: "RADIO FREQUENCY CONTROL IN SPACE TELECOMMUNICATIONS," 19 March 1960, and "POLICY PLANNING FOR SPACE TELECOMMUNICATIONS," 4 December 1960. The report catalogs and describes some of the recent technical, economic, and international developments in communication satellites and identifies some of the issues that will be of interest to the Congress. Includes a section discussing US-USSR relationship affecting communications satellite development, potential conflict area, significance of Soviet developments, and prospective Soviet domination of this medium of mass communication if United States does not take the lead. Appended among others: committees of Congress concerned about communication satellites; industry—Department of Defense cooperation in satellite-based telecommunications; launch vehicles for communication satellites; summary of Agency for International Development (AID) telecommunications projects; and President Kennedy's statement of February 7, 1962, and proposed bill for the creation of a Communications Satellite Corporation. Includes chronology of communication satellite events October 1945 to 7 February 1962.

COMMUNICATIONS SATELLITE LEGISLATION. HEARINGS BEFORE THE COMMITTEE ON SPACE SCIENCES, UNITED STATES SENATE, EIGHTY-SEVENTH CONGRESS, SECOND SESSION, ON S. 2650 A BILL TO AMEND THE NATIONAL AERONAUTICS AND SPACE ACT OF 1958, AS AMENDED, WITH RESPECT TO SPACE COMMUNICATIONS FACILITIES, AND FOR OTHER PURPOSES, AND S. 2814 A BILL TO PROVIDE FOR THE ESTABLISHMENT, OWNERSHIP, OPERATION, AND REGULATION OF A COMMERCIAL COMMUNICATIONS SATELLITE SYSTEM, AND FOR OTHER PURPOSES, FEBRUARY 27, 28, MARCH 1, 5, 6, AND 7, 1962. Washington, Government Printing Office, 1962. 485 p.

HEARINGS ON MILITARY POSTURE AND H. R. 9751 TO AUTHORIZE APPROPRIATIONS DURING FISCAL YEAR 1963 FOR AIRCRAFT, MISSILES, AND NAVAL VESSELS FOR THE ARMED FORCES, AND FOR OTHER PURPOSES. COMMITTEE ON ARMED SERVICES, U.S. HOUSE OF REPRESENTATIVES, EIGHTY-SEVENTH CONGRESS, SECOND SESSION. JANUARY 24, 25, 26, 29, 30, AND 31, FEBRUARY 1, 2, 6, 8, 14, 15, 16, 19, 20, 21, 23, 26, AND 28, 1962. Washington, Government Printing Office, 1962. 3157–3992. (No. 44.)

MANNED SPACE FLIGHT PROGRAM OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: PROJECTS MERCURY, GEMINI, AND APOLLO. STAFF REPORT OF THE COMMITTEE ON AERONAUTICAL AND SPACE SCIENCES, UNITED STATES SENATE, EIGHTY-SEV-

ENTH CONGRESS, SECOND SESSION, 4 SEPTEMBER 1962. Washington, Government Printing Office, 1962. 242 p. (Committee Print.)

A compilation of unclassified information gathered from committee hearings, supplemented by additional data collected from governmental agencies and independent sources. Appended: Department of Defense manned space flight project (X–20); also sampling of events in US space program April 1957 to 26 June 1962. With many illustrations.

METEOROLOGICAL SATELLITES. STAFF REPORT PREPARED FOR THE USE OF THE COMMITTEE ON AERONAUTICAL AND SPACE SCIENCES, UNITED STATES SENATE, BY THE LIBRARY OF CONGRESS, 29 MARCH 1962. Washington, Government Printing Office, 1962. 201 p. (87th Congress, 2d Session.)

This report is one of a series on important space matters that has been in preparation over the past year for the Committee on Aeronautical and Space Sciences by the Legislative Reference Service of the Library of Congress. The report is designed to describe some of the important background information, current programs, international implications, and future promise of meteorological satellites culminating in an operational worldwide weather prediction system. Among the appendixes: a chart of satellites carrying equipment for meteorological observations from 1958 to (proposed) 1964–70.

MILITARY CONSTRUCTION APPROPRIATIONS FOR 1963. HEARINGS BEFORE A SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS, HOUSE OF REPRESENTATIVES, EIGHTY-SEVENTH CONGRESS, SECOND SESSION, SUBCOMMITTEE ON MILITARY CONSTRUCTION. Washington, U.S. Government Printing Office, 1962. 3 pts. (H.R. 12870.)

MILITARY CONSTRUCTION APPROPRIATIONS FOR 1963. HEARINGS BEFORE THE SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS, UNITED STATES SENATE, EIGHTY-SEVENTH CONGRESS, SECOND SESSION, ON H.R. 12870, MAKING APPROPRIATIONS FOR MILITARY CONSTRUCTION FOR THE DEPARTMENT OF DEFENSE FOR THE FISCAL YEAR ENDING JUNE 30, 1963, AND FOR OTHER PURPOSES. Washington, U.S. Government Printing Office, 1962, 802 p.

PYRAMIDING OF PROFITS AND COSTS IN THE MISSILE PROGRAM. HEARINGS BEFORE THE PERMANENT SUBCOMMITTEE ON INVESTIGATIONS OF THE COMMITTEE ON GOVERNMENT OPERATIONS, UNITED STATES SENATE, EIGHTY-SEVENTH CONGRESS, SECOND SESSION, PURSUANT TO SENATE RESOLUTION 250, 87TH CONGRESS. PART 1 (NIKE PROGRAM) APRIL 3, 4, 5, 10, AND 11, 1962; PART 2 (NIKE PROGRAM) APRIL 11, 12, 13, 17, AND 18, 1962; PART 3 (ATLAS PROGRAM) MAY 15, 1962; PART 4 (BOMARC PROGRAM) MAY 22, 23, 24, AND 25, 1962. Washington, Government Printing Office, 1962. 4 pts.

This inquiry was directed to procurement practices and systems, and to the profits that accrue under such systems. The subcommittee desired to ascertain whether present procurement systems result in the pyramiding of profits and costs by the taking of profits in tiers of subcontracts. The subcommittee staff had studied several of our more expensive missile programs to determine whether the Government had paid unnecessary and excessive profits to companies under contract to the Defense Department. These studies were discussed during the hearings.

SPACE AND THE WEATHER. REPORT OF THE COMMITTEE ON SCIENCE AND ASTRONAUTICS, U. S. HOUSE OF REPRESENTATIVES, EIGHTY-SEVENTH CONGRESS, SECOND SESSION, SERIAL X, 3 DECEMBER 1962. Washington, Government Printing Office, 1962. 21 p. (Union Calendar No. 1071, House Report No. 2561.)

Progress of meteorological satellite development and weather modification; the evolution of the operational weather satellite system; international aspects of the weather satellite system; and progress being achieved in research on weather modification. Conclusion and recommendations on the NIMBUS and TIROS programs. Appended: Agreement Between National Aeronautics and Space Administration

and Department of Commerce—US Weather Bureau Concerning Implementation of NIMBUS Operational System (NOS).

WAYS AND MEANS OF EFFECTING ECONOMIES IN THE NATIONAL SPACE PROGRAM. HEARING BEFORE THE COMMITTEE ON SCIENCE AND ASTRONAUTICS U.S. HOUSE OF REPRESENTATIVES, EIGHTY-SEVENTH CONGRESS, SECOND SESSION, 24, 25, 26 JULY AND 16 AUGUST 1962. Washington, Government Printing Office, 1962. 193 p. (No. 17.)

The specific purpose of these hearings was to explore new methods, approaches, and techniques which would provide the Government with ways of introducing savings into the national space effort. Included are the testimonies of officials from NASA, Department of Defense, and industry.

WORK STOPPAGE AT MISSILE BASES. REPORT OF THE COMMITTEE ON GOVERNMENT OPERATIONS, MADE BY ITS PERMANENT SUBCOMMITTEE ON INVESTIGATIONS, UNITED STATES SENATE, EIGHTY-SEVENTH CONGRESS, SECOND SESSION, 29 MARCH 1962. Washington, Government Printing Office, 1962. 47 p. (Report No. 1312.)

This Subcommittee focused a large portion of this inquiry on Cape Canaveral. The remainder of the hearings was concerned with work stoppages at various ICBM sites around the country. The report includes, among others: an assessment of damage, discussion of the delay in the man-in-space program; union responsibility; excessive cost to Government; failures of management; and proposed corrective legislation.

IX. SOURCE MATERIALS AND REFERENCE WORKS

A. Astronautics—State-Of-The-Art: Comprehensive Sources.

AEROSPACE MANAGEMENT. ANNUAL HANDBOOK ISSUE: Philadelphia, Chilton, March 1962. 152 p.

Includes, among others: missile and booster directory; space vehicle directory; current R & D projects; directory of contractors; an article on DOD attitudes on long-range planning and management efficiency that have spawned a whole family of systems to aid management; data on Russia's aerospace arsenal (aircraft, missiles and space boosters, and space vehicles—pages 92 to 110); guidance systems—marketing and procurement directory; ground effect machines and VTOL's and powerplants (propulsion progress, rocket motor and directory.)

DESIGN GUIDE TO ORBITAL FLIGHT, by Jorgen Jensen and others. New York, McGraw-Hill, 1962. 896 p.

This design guide to orbital flight was prepared by the Aerospace Division of Martin Marietta Corporation as a tool for analysis of basic orbital problems. Much of the information in this book is developed from earlier studies supported by the Navigation and Guidance Laboratory of the Wright Air Development Division (USAF). Wernher von Braun in the foreword to the book states in part: "Here, for the first time, a ready reference on satellite flight mechanics is available for vehicle design engineers. In this volume, the emphasis has been on material needed for earth-orbital operations, since this is the first step that man will have to master before he can leap to the Moon and the planets and since men and supplies will probably be transported by 'space trucks' and 'space buses' into orbit around the earth before assembling into space stations and lunar or interplanetary vehicles." With chapters on: orbit mechanics, physical data, orbit perturbations, satellite lifetimes, ascent to orbit, maneuvers, satellite rendezvous, satellite recovery, satellite re-entry, satellite orbit computation, guidance and control requirements, and mission requirements. With graphs, monograms, and tables.

EXPRESS TO THE STARS, by Homer E. Newell. New York, McGraw-Hill, 324 p.

The author is Deputy Director of Space Flight Programs at the Headquarters of U.S. National Aeronautics and Space Administration and his book is about the rocket in action. Some of the subjects covered are: how a rocket works; rockets in flight; construction of the rocket; instrumentation; the firing range;

sounding rockets; missiles; the rocket plane; and what is man doing and planning to do to extend his dominion of the space. Illustrated. Glossary.

MISSILE AND SPACE PROJECTS GUIDE 1962, by Horace Jacobs and Eunice Engelke Whitney, New York. Plenum, 1962. 235 p.

In the preface the authors state: "The Missile and Space Projects Guide has been prepared to provide aerospace scientists, engineers, market analysts, planners, and other specialists with basic information on the numerous existing and space projects. It is the first book of its kind in that it assembles in one volume reference information on nearly all projects, planned or actual, including concepts, studies, or hardware, that have been mentioned in the open literature. A number of missile and space guides, dictionaries, glossaries, or handbooks have been published, but none is centered about the 'project' in its broadest sense . . . ."

1963 CAPABILITIES HANDBOOK, in *Aerospace Management*, v. 6, no. 3 (Mar 1963) 54–163.

A procurement and marketing reference, arranged according to the following ten sections and detailing the capabilities of each parent contractor and/or its divisions: airframe, propulsion, guidance and navigation, AGE and production equipment, electronics and instrumentation, management services, tracking and telemetry, controls, life support, and research and study. Each section contains: contractors active in aircraft, missiles, spacecraft and support facilities; plant locations and telephone numbers; and demonstrated capability by project and product.

1001 QUESTIONS ANSWERED ABOUT SPACE, by Clarke Newlon. New York, Dodd, Mead, 1962. 355 p.

In the foreword the author states: "....The material for 1001 Questions Answered About Space comes from 1001 sources, all open and unclassified. They included reports, papers and studies from the National Aeronautics and Space Administration, the Department of Defense, the three Military Services, the Atomic Energy Commission, the National Academy of Sciences and both Houses of Congress; from innumerable conversations with government officials, university scientists, industry representatives, researchers and engineers." With chapters on: what space means to you; the cosmic bodies; the language of space; the history of space exploration; the techniques of space exploration (including telemetry guidance, inertial guidance, materials, re-entry vehicles); space power sources; US space-launched vehicles; unmanned space systems; manned space systems; the human side of space; the search for life in space; space and the future; the military in space; space and the law; conquering space through research; the US space agencies; and biographies.

R & D TECHNICAL HANDBOOK; A REFERENCE TO AEROSPACE TECHNOLOGIES 1962–1963. Washington, Conover-Mast Publications, July 1962. Various paging.

Includes information on: systems planning; dynamics and structures; propulsion; electronic systems; electronic components; accessory components; materials; production engineering; and support systems.

ROCKET ENGINES, by S. L. Bragg. London, George Newnes Limited, 1962. 158 p.

The purpose of this book is to provide "science and engineering students, of university or technical college standard, with the basic theory needed to help them become competent rocket engineers. The theoretical treatment is therefore fairly detailed, and references to actual practice are generalized as far as possible." The author has tried, however, to stress the physical reasoning behind the mathematics. The scope of the volume has largely been determined by the author's experience in working on the development of engines for the British Blue Streak. He has attempted to include, or give references to, all the fundamental theory found needed in this exercise. Where theory has been "less than adequate . . . . a fair summary of current opinion has been attempted. Descriptive detail of individual engine designs has been avoided."

SECOND ANNUAL NASA ISSUE, in *Missiles and Rockets*, v. 11, no. 22 (26 Nov 1962) 39–180.

NASA's $50-Billion undertaking to put men on the Moon and begin exploitation of space within this decade has made impressive progress in the past year. Funding to support the massive national effort, set at $3.7 billion in Fiscal Year 1963, will escalate to at least $5.5 billion—half again as much—in Fiscal Year 1964. Missiles and Rockets' Second Annual NASA Issue surveys the space agency effort by programs—what is to be accomplished in the relatively near future and what may be achieved by 1970. This special issue of the magazine examines overall budget plans and how NASA will procure what it needs from industry. This is followed by articles covering the programs involved in manned cislunar and lunar exploration, followed by reports on advanced manned and unmanned projects, launch vehicles, propulsion development, and the myriad satellite programs. A separate story deals with the huge construction program necessitated by the space effort. A final section contains up-to-date organizational charts of NASA's centers and a rundown of their functions and responsibilities in the US space endeavor.

SPACE FLIGHT. II. DYNAMICS, by Krafft A. Ehricke. Princeton, D. Van Nostrand, 1962. 1210 p. (Principles of Guided Missile Design.)

The subject of space flight is treated within the series Principles of Guided Missile Design in a subsidiary three-volume work by Krafft A. Ehricke. This second volume attempts to cover the broad subject of dynamics of space vehicles under the influence of a large variety of forces, gravity, high thrust, low thrust, micro-thrust, drag and radiation pressure. The first part of the book deals with free motion and impulsive velocity changes. The second part treats the dynamics of powered flight. The third part applies the basic theory to lunar and interplanetary mission profiles.

THE SPACE RACE: FROM SPUTNIK TO APOLLO AND BEYOND, by Donald W. Cox. Philadelphia, Chilton, 1962. 393 p. (Foreword by the Honorable J. W. Fulbright, Chairman of the U.S. Senate Committee on Foreign Relations.)

". . . . Covers the major cosmic-shaking events of the critical past half-decade with a survey of the reasons why the United States continues to lag behind the Soviets in achieving notable firsts in space." The book contains many references on US Army, Navy, and Air Force programs. In seeking a way to thwart the Communist dreams of control of the cosmos, the author offers a long-range 40-year grand assault on space, cooperating with the Soviets through the United Nations. Appended: a graph showing USSR-US space race 4 October 1957—January 1963; also Space Race Timetable for the Cosmic Sixties (US-USSR) 1962 to 1969.

B. Bibliographic Data.

AERONAUTICAL AND SPACE SERIAL PUBLICATIONS, A WORLD LIST. Washington, Library of Congress, Science and Technology Division, 1962. 255 p.

This list is an attempt to provide a survey on a world-wide basis of "the whole range of aeronautical and astronautical serial literature," including periodicals, documents, annuals, numbered monographic series, et cetera. This list contains 4,551 titles originating in 76 countries.

ANNOTATED BIBLIOGRAPHY OF SPACE SCIENCE AND TECHNOLOGY WITH AN ASTRONOMICAL SUPPLEMENT, by Frederick I. Ordway, III. 3d. ed. Washington, Arfor Publications, 1962. 77 p.

A history of astronautical book literature 1931 through 1961. Titles appearing in the 1930s; titles appearing in the 1940s; and titles appearing 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, and 1961. Author index. Title index.

ARMS CONTROL: SELECTED BIBLIOGRAPHY, by S. L. Harrison. Washington, Institute of Defense Analysis, Weapons Systems Evaluation Division, 1962. 28 p.

The subject matter has been categorized into the following topics of interest: I. INTRODUCTION AND BACKGROUND; II. POLITICAL IMPLICATIONS; III. TECHNICAL ASPECTS; IV. NUCLEAR DIFFUSION; V. GENERAL. The role of missiles in warfare, and missile strategy is the subject of many of the publications included in this bibliography.

AUTHOR-SUBJECT INDEX TO ARTICLES IN SMITHSONIAN ANNUAL REPORTS 1849–1961, comp. by Ruth M. Stemple. Washington, Smithsonian Institution, 1963. 200 p. (Publication 4503.)

Includes: astronomy, meteorology, plants and other subjects pertinent to this bibliography.

BASIC RESEARCH RESUMÉS, 1961–1962; A SURVEY OF BASIC RESEARCH ACTIVITIES OF THE OFFICE OF AEROSPACE RESEARCH. Washington, Herner and Co., 1962. 588 p. (OAR–9.)

Prepared for the Office of Aerospace Research, USAF. This book reports, describes, classifies and indexes with abstracts about 2500 intra- and extramural Air Force research efforts current during fiscal 1961–1962. Of interest to this bibliography are the reports which appear under the following subject categories: atmospheric physics and meteorology, space physics, behavior sciences, biological and medical sciences, among others.

EXPLORATION OF SPACE, by Paul Ax. San Francisco, APO 929, Itazuke Base Library, 1962. 67 p. (PACAF Basic Bibliographies for Base Libraries.)

A selected annotated list of books dealing with: rocket-missile history and research; space flight—the overall picture; satellites; space medicine; man in space programs; the Moon and interplanetary travel; and space exploration and missile periodicals.

A GUIDE TO THE USE OF UNITED NATIONS DOCUMENTS, by Brenda Brimmer and others. Dobbs Ferry, N. Y., Oceana Publications, 1962. 272 p.

Including reference to the specialized agencies and special U. N. bodies. The chapters are: 1. THE DOCUMENTATION SYSTEM; 2. THE METHOD OF RESEARCH; 3. RESEARCH AND THE LIBRARY; 4. RESEARCH AND THE LIBRARIAN; 5. BASIC TOOLS AND GUIDES; 6. TOOLS AND GUIDES ON THE BACKGROUND OF THE U. N.; 7. TOOLS AND GUIDES BY ORGAN; 8. TOOLS AND GUIDES BY GENERAL SUBJECT; 9. TOOLS AND GUIDES TO THE SPECIALIZED AND RELATED AGENCIES. Appended: Selected List of Office of Public Information Material; List of Symbols for United Nations Press Releases; List of Common Abbreviations in the Documents; Selected List of U. N. Library Publications by Series Symbol; Categories, Documents, Symbols and Classifications Systems of Selected Specialized Agencies; Organization Charts. Bibliography.

INDEX OF NASA TECHNICAL PUBLICATIONS WITH ABSTRACTS; JULY 1960—DECEMBER 1961. Washington, U. S. National Aeronautics and Space Administration, 1962. 262 p. (NASA SP–9.)

This index of NASA Technical Publications is the last that will be issued. [It has been replaced by an enlarged and revised Technical Publications Announcements (TPA), which is NASA's announcement and index journal.] Among the categories listed in the index: communications, navigation, and guidance; instrumentation; life sciences and life support systems; propellants and fuels; propulsion—rocket units; space sciences; space vehicles; spacecraft; thermal phenomena. With subject, author and report number index.

A MISSILE AND SPACE BIBLIOGRAPHY, by Maj. James E. Sunderman, in *Air Force*, v. 45, no. 4 (April 1962) 175–176 plus.

A select listing of recent and current writings on the important aspects of aerospace, especially on rockets and missiles, astronautics, spaceflight, "Then Men," earth satellites, and reference and research.

MISSILES AND VENTURES INTO SPACE: PROGRESS REPORT 1961–1962. Washington, Headquarters, Department of the Army, June 1962. 107 p. (DA Pam 70–5–10.)

Includes approximately 700 unclassified titles, partly abstracted and annotated, and selected from periodicals, books, and studies. Includes information on: US missile/space projects and programs; missile progress in other free nations of the world; missiles and space activities in the USSR; and space exploration and interplanetary flight. With listing of dictionaries, encyclopedias, and directories, and a chart showing functional organization of the Federal Government for space and missile programs.

PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF SPACE FLIGHT: A BIBLIOGRAPHY. VOLUME I. ACCELERATION, DECELERATION, AND IMPACT, by J. F. Price. Redondo Beach, California, Space Technology Laboratories, October 1962. 368 p. (Research Bibliography No. 43, 9990–6302–KU–000.)

This bibliography, consisting of 1020 references (mostly annotated) on acceleration, deceleration and impact studies, is the first of a series of volumes pertaining to the physiological effects of space flight.

PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF SPACE FLIGHT. VOLUME II: WEIGHTLESSNESS AND SUBGRAVITY, by J. F. Price. Redondo Beach, California, Space Technology Laboratories, Inc., 1963. 165 p. (Research Bibliography No. 44.)

With 385 references, mostly annotated, the majority of which were published during the period January 1952 to November 1962. Author, agency, periodical, subject and ASTIA indices are included.

PLANETARY ATMOSPHERES AND RELATED INFORMATION; A BIBLIOGRAPHY, by E. Colabrese. King of Prussia, Pa., General Electric, Space Sciences Laboratory, October 1961. 78 p. (R61SD126.)

"Although the composition of the planetary atmospheres is the prime concern of this bibliography, articles and reports on other aspects of the planets, such as surface features, temperature properties and radiation measurements have been included. Section I contains 169 references on the Planetary System in general; Section II–159 references on Mars; Section III–90 references on Venus; Section IV–49 references on Jupiter; Section V–15 references on Saturn; and Section VI–23 references on Interplanetary Space and Exploration. Approximately one fourth of the references are abstracted . . . . Within each of the six sections, references are arranged alphabetically by author."

RELIABILITY ABSTRACT AND TECHNICAL REVIEWS. Washington, National Aeronautics and Space Administration, 1962. Various paging. (1961–1962 First Annual Volume Abstracts 1–275.)

SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS, v. 1, no. 3 (8 Feb 1963).

"STAR is a comprehensive abstracting and indexing service devoted solely to report literature bearing on the science and technology of aeronautics and space," and is prepared by the Scientific and Technical Information Facilities, operated for NASA by Documentation Inc. This publication is published twice each month, commencing in 1963, and provides coverage of: scientific and technical reports of NASA and its contractors; scientific and technical reports of government agencies, universities, and industrial and independent research organizations in the US and abroad; and scientific and technical articles by NASA and contractor authors which appear in learned and technical journals. One section of the periodical contains complete bibliographic citations with informative abstracts, arranged by appropriate subject categories, some examples of which are: astronomy and astrophysics; communications; electronics; meteorology; navigation and guidance; propellants and propulsion; space radiation, sciences, vehicles; et cetera. With subject and author index.

SELECT LIST OF PUBLICATIONS ISSUED BY SENATE AND HOUSE COMMITTEES. COMMITTEE ON GOVERNMENT OPERATIONS, UNITED STATES SENATE, EIGHTY-SEVENTH CONGRESS, FIRST SESSION. Washington, Government Printing Office. 1961. 428 p. (Committee Print.)

Committee Prints, Staff Studies, Reports, and Documents, 80th-86th Congresses (1947–60, inclusive), including those of missile and space activities.

C. Biographies.

ADMIRAL ARLEIGH (31-Knot) BURKE, by Ken Jones and Hubert Kelley, Jr. Philadelphia, Chilton Books, 1962. 203 p.

This biographical account of the life and military career of Admiral Burke includes information on the role played by him as Chief of Naval Operations in helping to shape US missile policies.

MEN OF SPACE, by Shirley Thomas. Volume 4. Philadelphia, Chilton, 1962. 284 p.

This is the fourth in the series of profiles of the leaders in space research, development, and exploration. It presents the biographies of Jack Armstrong, Robert R. Gilruth, Samuel Herrick, John R. Pierce, Malcolm D. Ross, William Shockley, Harrison A. Stroms, and Hubertus Strughold. Volume 3 of the series (1962) presented the biographies of James H. Doolittle, C. Stark Draper, Louis G. Dunn, Don D. Flickinger, Yuri Alekseyevich Gagarin, Arthur Kantrowitz, William F. Raborn, Jr., Harold W. Ritchey, Alan B. Shepard, Jr., and H. N. Toftoy. Volume 2 in the series (1961) presented biographies of A. Scott Crossfield, Thomas F. Dixon, Walter R. Dornberger, Hugh L. Dryden, W. Randolph Lovelace II, William H. Pickering, Simon Ramo, Edward Teller, Robert C. Truax, and Fred L. Whipple. Volume 1 of the series (1960) presented the biographies of Krafft A. Ehricke, Robert H. Goddard, Bernard A. Schriever, John Paul Stapp, Konstantin Edouardovich Tsiolkovsky, James A. Van Allen, Wernher von Braun, Theodore Von Karman, John Von Neumann, and Charles E. Yeager. Each volume contains photographs.

MEN OF SPACE, by Shirley Thomas. Philadelphia, Chilton Books, 1962. 300 p. (Volume 5.)

Each chapter tells a story "of the most powerful force on Earth . . . . This power is man." The book is devoted to the following profiles of leaders in space research, development, and exploration: Donald L. Putt, Eugene M. Emme, Marvin W. McFarland, Grayson Merrill, Frank Pace, Jr., Frank E. Sorenson, Stuart Symington, E. C. Welsh, John H. Glenn, Jr., Albert R. Hibbs, Richard B. Kershner, Homer E. Newell, L. Eugene Root, Robert C. Seamans, Jr., Charles H. Townes, and Roger S. Warner, Jr.

MODERN AMERICANS IN SCIENCE AND TECHNOLOGY, by Edna Yost. New York, Dodd, 1962. 175 p.

Sketches of various American scientists of the present century whose work helped man to pass from Machine Age into Space Age. Elmer Sperry 1860–1930; George Washington Carver 1864–1943; Leo Hendrik Baekeland 1863–1944; Willis H. Carrier 1876–1960; Charles F. Kettering 1876–1958; Frederick G. Cottrell 1877–1948; Robert R. Williams 1886–; Emil Truog 1884–; Vladimir K. Zworykin 1889–; Enrico Fermi 1901–1954; Paul Allman Siple 1908–; Robert Hutchings Goddard 1882–1945 whose experiments and patents for rocket apparatus were world "firsts" and are basic to all interplanetary space flight today; and John P. Hagen, 1908–, who helped lay the foundations of the new science of radio astronomy before becoming director of our first earth satellite project.

SPACE SCIENTISTS AND ENGINEERS: SELECTED BIOGRAPHICAL AND BIOGRAPHICAL LISTINGS, 1957–1961. Washington, U.S. National Aeronautics and Space Administration, 1962. 332 p. (NASA SP–5.)

This listing describes a segment of the society of scientific people who are making significant contributions to the advancement of space science and technology. The listing is by country and includes: United States, Australia, Austria, Belgium, Canada, France, Great Britain, India, Israel, Italy, Japan, the Netherlands, Norway, Poland, Sweden, Switzerland, U.S.S.R., and West Germany.

D. Charts, Scoreboards, Logs, etc.

AEROSPACE FACTS AND FIGURES 1962, ed. by Ben S. Lee. Washington, American Aviation Publications, 1962. 168 p.

Missiles, spaceprograms, and related information.

ASTROLOG, in *Missiles and Rockets*, v. 10, no. 19 (7 May 1962) 23–29; v. 11, no. 1 (2 July 1962) 19–27; no. 10 (3 Sept 1962) 19–30; v. 12, no. 1 (7 Jan 1963) 25–32; no. 9 (4 Mar 1963) 27–34.

Charts showing current status of US missile and space programs plus all orbiting satellites, and indicating project name, contractors, description, and status.

A LOOK AT AMERICA'S MISSILE ARSENAL, in *U.S. News and World Report*, v. 54, no. 11 (18 Mar 1963) 66–68.

A review of our missile arsenal showing by photos accompanied by brief descriptions and other data such as deployment, quantities, et cetera: big missiles able to hit Russia's homeland, missiles for defense against enemy air-

craft, battlefield missiles for use against enemy troops, missiles fired by planes at enemy planes, missiles to hit other missiles, antisubmarine missiles, and bomber-borne missiles.

MISSILES AND SPACE SYSTEMS—1962, by H. H. Koelle, in *Astronautics*, v. 7, no. 11 (Nov 1962) 29–37.

The progress of missiles and space systems in the past 14 months. "With vast missile programs leveling out, and our immediate space objectives well in hand, we must look to the future—to plans for extensive lunar and interplanetary travel—to evaluate the space program's 'state-of-the-art vs. time curve'." With a condensed log of the progress of the last 14 months.

SATELLITE SCOREBOARD . . . . US AND USSR, by Richard M. Skinner, in *Air Force*, v. 45, no. 4 (Apr 1962) 108–113 plus.

A compilation of the American and Russian space launchings by programs since October 1957 "when the new age dawned," including all available relevant data on vehicles used, purposes and launches, and the nature of experiments performed.

SATELLITES, LUNAR PROBES, AND SPACE PROBES TO JUNE 5, 1962, in *Military Engineer*, v. 54, no. 360 (July–Aug 1962) 236–239.

A tabulation of successful space launchings from the first SPUTNIK I on Oct. 4, 1957 to DISCOVERER XIX, on Dec. 20, 1960 was published in the Mar-Apr 1961 of Military Engineer. The status of each unit launched was given as of Jan. 13, 1961. Changes that have occurred since that time or revised data are indicated in this present listing up to June 5, 1962. All other entries in the original table remain as published. Following the revision all successful launchings known or announced are tabulated through June 2, 1962, giving their status as of June 5. The tables list name, lifetime (launch date and terminal date), payload weight in flight (lbs) form, perigee (miles), apogee (miles), short-term launch vehicle, and purpose.

SPACE ACTIVITIES SUMMARY, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 137.

Successful orbital space activities, both American and Russian, from 1957 through 1962, listing year, the satellite orbited, and weight in orbit. Also American failures. Russian failures not listed since they are not announced.

SPACE AGE CATALOGUE (IV), in *Interavia*, v. 17, no. 10 (Oct 1962) 1299–1300.

A chart surveying successful satellites and space probes as of mid-September, 1962. "(Over 20 US satellites are omitted because of military security.)" The chart supplies the following information: name, country, weight, date of launch, life, launch site, booster, launch weight, perigee, apogee, inclination, orbital period, objectives and results, and also some accompanying remarks.

SPACE VEHICLE LOG, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 193.

First chart shows the following information for satellites transmitting data (1958–1962): name, source (US, Canada, and USSR), launch date, inclination, period, apogee, perigee, transmitting frequency, and weight in orbit. Second chart on other 1962 launches supplies the following information: payload/vehicle, source, launch, decay, et cetera.

U.S. LAUNCH VEHICLES, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 191–192.

Chart of basic vehicles and second stages for complete vehicles, showing: vehicle name, user agency, vehicle contractor, propulsion, stage contractor and designation, propellant, nominal thrust, max. diameter, height, gross launch weight, and payload.

U.S. MISSILES — SPECIFICATIONS, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 187–188.

Chart showing: missile category; name; designation; cognizant service (Army, Navy, Air Force); system manager or prime contractor; research,development, production, or service use status; associate contractor or manufacturer; max. length; max, span, wings or fins; body diameter; launch weight; powerplant data; guidance data; max. range; et cetera.

U.S. SOUNDING ROCKETS—SPECIFICATIONS, in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 195.

Chart showing following information: manufacturer, name, agency, overall length, diameter, launch weight, powerplant, et cetera.

[U.S. SPACECRAFT AND INTERNATIONAL SPACECRAFT — SPECIFICATIONS], in *Aviation Week and Space Technology*, v. 78, no. 10 (11 Mar 1963) 189–190.

Chart showing: category; spacecraft name; agency; prime hardware contractor; max. injected weight; earth orbit altitude; date of first launch; total successful missions; launch vehicle; et cetera.

E. Conferences, Proceedings, Symposia, etc.

ENGINEERING FOR SPACE—A SUMMARY, in *Military Engineer*, v. 54, no. 360 (July-Aug 1962) 249–254.

A collection of summaries of papers presented at the Symposium of the Society of American Military Engineers as part of the 42nd Annual Meeting, May 21 and 22, 1962. The following are some of the representative presentations: NUCLEAR POWER AND SPACE EXPLORATION, by George Sege; 120-INCH SOLID FUEL ROCKET MOTOR, by Christopher Fitzgerald; METEOROLOGICAL SATELLITES — PAST PERFORMANCE AND FUTURE IMPLICATIONS, by Morris Tepper; THE UTILIZATION OF ARTIFICIAL SATELLITES, by Lt. Comdr. Eugene A. Taylor; MAN-MACHINE CONSIDERATIONS IN SATELLITE AND PLANETARY OPERATIONS, by Albert A. Glass; THE NATION NEEDS A LUNAR LABORATORY, by Emil deGraeve; LUNAR CONSTRUCTION, by Brig. Gen. William C. Hall; ENGINEERING AND DESIGN IN THE SPACE AGE, by Comdr. Wayne J. Christensen; et cetera.

EXPLORATORY CONFERENCE ON MISSILE MODEL DESIGN FOR RELIABILITY PREDICTION; FOURTH MEETING 24–25 MAY 1961. New Mexico, White Sands Missile Range, Ordnance Mission, 1961. 180 p.

"Three conferences have been held at White Sands Missile Range for the purpose of exploring methods of developing mathematical models of missile systems. The last conference was held in April 1959. In these conferences major emphasis was placed on formulating plans leading to probabilistic simulation models which would include stochastic inputs in a missile system simulation on analog and digital computers. The representatives of governmental agencies, research organizations and defense contractors attending the third conference were desirous of meeting again when achievements along the line of improved models warranted such a meeting. The Fourth Probabilistic Models Symposium was set up so that several organizations could present the results of their work and an exchange of ideas could be affected." Among the papers presented: A PROBABILITY MODEL FOR THE PREDICTION AND EVALUATION OF THE RELIABILITY OF A COMPLEX SPACE SYSTEM, by Landis S. Gephart and others; CIRCUIT FAILURE ANALYSIS USED IN DESIGN OF MINUTEMAN GUIDANCE AND CONTROL SYSTEM, by W. J. West.

HOST OF NEW SPACE VEHICLES PROPOSED, in *Missiles and Rockets*, v. 12, no. 4 (28 Jan 1963) 17–18.

A report of the new proposals for space vehicles made at the January meeting of the Institute of the Aerospace Sciences in New York. Also projects and proposals on: pilot and crew performances, upper atmosphere, nuclear propulsion, re-entry guidance and control, and space material problems.

LIFTING VEHICLE PROBLEMS ATTACKED, by William Beller, in *Missiles and Rockets*, v. 11, no. 19 (5 Nov 1962) 17–18.

The post-APOLLO challenge of devising lifting vehicles to enter planetary atmospheres is demanding research as new and strange as the environment to be studied. One major result is that inter-discipline attacks are being mounted against the technical problems involved. The first organized meeting occurred in Phila. in October at the "Symposium on Dynamics of Manned Lifting Planetary Entry," jointly sponsored by the Air Force Office of Scientific Research and the Space Sciences Laboratory of General Electric Co. Some of the discussions revolved around: prestressed pyrolytic graphite, plasma power, re-entry shapes, Venusian

atmosphere, transmitting through plasma, et cetera.

MANNED PROGRAMS KEYNOTE ARS, in *Missiles and Rockets*, v. 11, no. 21 (19 Nov 1962) 14–17.

Hardware and systems engineering for the rapidly expanding US manned space program dominated the 1962 American Rocket Society annual meeting and exhibition in Los Angeles. From tiny Project GEMINI explosive devices to full-scale boiler-plate models of the APOLLO command and service modules, primary attention of the meeting was focused on advanced manned space efforts. This special report touches on discussions concerning computer advances, technical papers, et cetera.

MAN'S DEPENDENCE ON THE EARTHLY ATMOSPHERE, ed. by Karl E. Schaefer. New York, Macmillan, 1962. 416 p.

Proceedings of the First International Symposium on Submarine and Space Medicine, which was sponsored by the Advanced Research Projects Agency in cooperation with American Institute of Biological Sciences under ONR contract Nonr 2673(00). The symposium provided a comprehensive review of the latest pertinent developments in the field of environmental physiology and cited the problem areas in which research is urgently needed.

[MATERIALS FOR SPACE TECHNOLOGY SYMPOSIUM ISSUE], in *British Interplanetary Society Journal*, v. 18, no. 9 (May–June 1962) 319–382.

A symposium on material in space technology, organized by the Society, was held in London on 22 Nov. 1961. Details of the program are given and the following papers and discussions are presented in this issue: A GENERAL SURVEY OF THE MATERIALS PROBLEM, by A. J. Murphy; POLYMERS IN SPACE, by N. H. Langton and A. L. Soden; MAGNESIUM IN SPACE TECHNOLOGY, by E. F. Emley; ALUMINUM IN SPACE ENGINEERING, by E. G. West; HIGH-STRENGTH STEELS, by F. J. Wilkinson; THE DEVELOPMENT OF NOZZLE MATERIALS, by D. Bunting; THE USE OF GRAPHITE IN SPACE TECHNOLOGY, by A. E. S. White and R. K. Hurden; and THE EFFECT OF RADIATIONS ENCOUNTERED BY MATERIALS IN SPACE, by R. S. Barnes.

PROCEEDINGS OF THE IAS AEROSPACE SYSTEMS RELIABILITY SYMPOSIUM, SALT LAKE CITY, UTAH APRIL 16–18, 1962. New York, Institute of Aerospace Sciences, 1962. 251 p.

Among the papers presented: STRUCTURAL RELIABILITY ON RE-ENTRY VEHICLES USING BRITTLE MATERIALS IN PRIMARY STRUCTURE, by L. D. Gregory and C. E. Spruill; OPTIMUM DEVELOPMENTAL LAUNCH PROGRAMS, by S. H. Chasen; SPACE ENVIRONMENTS AND RELIABILITY OF HYDRAULIC CONTROLS, by A. B. Billet; THE PREDICTION AND MEASUREMENT OF HUMAN RELIABILITY, by D. Meister; RELIABILITY THROUGH PROPELLANT RESEARCH AND DEVELOPMENT, by E. S. Haniuk and B. L. Baird.

PROCEEDINGS OF THE IAS NATIONAL SYMPOSIUM ON TRACKING AND COMMAND OF AREOSPACE VEHICLES. New York, Institute of the Aerospace Sciences, 1962. 164 p.

The Symposium was held in San Francisco, 19–21 Feb. 1962 and was sponsored by the Institute. Partial contents: MINUTEMAN—A PROGRESS REPORT, by S. C. Phillips; RECENT SOVIET ADVANCES IN AEROSPACE TECHNOLOGY, by F. J. Krieger; FUTURE MILITARY SPACE SYSTEMS, by J. F. Whisenand; AEROSPACE CORPORATION AND SATELLITE CONTROL ENGINEERING, by R. G. Stephenson and R.C. Hansen; SPACE CONTROL ENVIRONMENT, by R.M.Wray; NASA GROUND SUPPORT INSTRUMENTATION, by R. D. Briskman; THE U. S. NAVY TRANSIT NAVIGATIONAL SATELLITE SYSTEM, by James C. Quillan, Jr.; THE U.S. NAVY SPACE SURVEILLANCE SYSTEM, by C. E. Cleeton; DEPARTMENT OF THE ARMY TRACKING OF MISSILES AND SPACECRAFT, by Harold Szweigbaum; et cetera.

PROCEEDINGS OF THE NATIONAL MEETING ON MANNED SPACE FLIGHT. New York, Institute of the Aerospace Sciences, 1962. 318 p.

This is an unclassified portion of the proceedings of the meeting held in St. Louis, Mo., 30 Apr–2 May 1962 and cosponsored by the Institute and NASA. Partial contents of this publication: THE NEW ERA OF EXPLORATION, by George Miller; ORGANIZING FOR THE CONQUEST OF SPACE, by D. B. Holmes; THE MILITARY CONTRIBUTION SPACE EXPLORATION, by B. A. Schriever; DESIGN FOR MANNED SPACE FLIGHT, by Robert R. Gilruth; EXPERIENCE WITH MERCURY SPACECRAFT SYSTEMS, by J. F. Yardley; MERCURY OPERATIONAL EXPERIENCE, by C. C. Kraft, Jr.; LIFE SCIENCES ACTIVITIES ASSOCIATED WITH PROJECT MERCURY, by S. C. White andC. P. Laughlin; ADVANCED ENVIRONMENTAL SYSTEMS, by J. L. Mason and W. L. Burress; RENDEZVOUS GUIDANCE TECHNOLOGY, by Robert S. Swanson and Peter W. Soule; DESIGN COMPARISON OF LUNAR RETURN CONFIGURATIONS, by E. Offenhartz and others; SELF-ERECTING MANNED SPACE LABORATORY, by R. Berglund and E. A. Weber; RE-ENTRY MATERIALS, by D. L. Kummer and H. J. Siegel; CREW SAFETY AND SURVIVAL ASPECTS OF THE LUNAR-LANDING MISSION, by Hubert M. Drake; PARAGLIDER RECOVERY SYSTEMS, by F. M. Rogallo; EFFECT OF STERILIZATION IN SPACECRAFT DESIGN, by Albin M. Nowitzky; THE POTENTIAL FOR NUCLEAR PROPULSION FOR MANNED SPACEFLIGHTS, by Maxwell W. Hunter, Jr.; MANNED LUNAR LANDING VIA RENDEZVOUS, by F. Digesu; et cetera.

PROCEEDINGS OF THE SECOND NATIONAL CONFERENCE ON THE PEACEFUL USES OF SPACE: SEATTLE, WASHINGTON MAY 8–10, 1962. Washington, D.C., U.S. National Aeronautics and Space Administration, November 1962. 282 p. (NASA SP–8.)

The principal addresses were: THE ROLE OF GOVERNMENT IN SCIENTIFIC EXPLORATION, by James E. Webb, Administrator, NASA; SAILING IN NEW AND OLD OCEANS, by Roger Revelle, Science advisor to the Secretary of the Interior; THE NEW WORLD OF SPACE, by Lyndon B. Johnson, Vice President of the United States. The sessions were concerned with space science as pertaining to Earth, Sun, Stars, Moon and Planets; nuclear energy as an energy source for space exploration; meteorological satellites; NASA communications satellite program; tracking and data acquisitions; Projects MERCURY and GEMINI; Project APOLLO; launch vehicles and launch operations; applications of space technology; and report on manned space flight. The subjects of panel discussion were: HOW WILL SPACE RESEARCH AFFECT YOUTH'S FUTURE; also IMPACT OF SPACE PROGRAMS ON SOCIETY.

PROCEEDINGS OF THE 6TH SYMPOSIUM ON BALLISTIC MISSILE AND AEROSPACE TECHNOLOGY, ed. by C. T. Morrow and others. New York, Academic Press, 1961. 4 Vols.

The Symposium was held in Los Angeles, California, in August 1961 and was sponsored by Headquarters, Office of the Deputy Commander, Air Force Systems Command, for Aerospace Systems, and Aerospace Corporation. VOLUME I: DESIGN AND RELIABILITY AND INVITED ADDRESSES; VOLUME II: BALLISTIC MISSILE AND SPACE ELECTRONICS; VOLUME III: PROPULSION, SPACE SCIENCE AND SPACE EXPLORATION; VOLUME IV: RE-ENTRY.

A REVIEW OF SPACE RESEARCH. Washington, National Academy of Sciences, National Research Council, 1962. Various paging. (Publication 1079.)

The report of the Summer Study conducted under the auspices of the Space Science Board of the National Academy of Sciences at the State University of Iowa, Iowa City, Iowa, June 17–August 10, 1962. The study was undertaken in response to a request and supported by a grant from the National Aeronautics and Space Administration (NASA), to examine the current national program of basic research in space and its future objectives. The contents deal with astronomy, celestial mechanics, lunar astronomy, particles and field, meteorological rockets and satellites, biology, space probe sterilization, the scientific role of man in space exploration, NASA/university relationships, block allocation of payload space, scientific uses of spacecraft launched by other Federal agencies, inter-

national cooperative programs, some special implications of the space program, and briefings of the NASA space science program.

REVISED MANNED FLIGHT PLANS OUTLINED, in *Missiles and Rockets*, v. 11, no. 4 (23 July 1962) 16–17.

At the July 1962 American Rocket Society meeting, industry and government officials spelled out additional details of lunar missions. The revised pattern of NASA's manned space flight program, including new projects were more clearly defined. The following list of future vehicles proposed in NASA's manned spaceflight program was drawn from papers presented: The "BUG"—the announced APOLLO lunar-orbit-rendezvous ejection vehicle; lunar logistics vehicle; two-man APOLLO craft; twenty-or-more-million-pound "Super" NOVA; six-man spacecraft; and earth-orbiting space station. NASA is reported to be working closely with the Academy of Sciences and the scientific community to determine other scientific experiments to be made on the Moon.

ROCKET PROPULSION TECHNOLOGY. VOLUME I. ed by D. S. Carton and others. New York, Plenum Press. 1961. 374 p.

This volume contains all the seventeen papers that were read and discussions that took place at the First Rocket Propulsion Symposium, Cranfield, England, January 1961. They deal with controlability of liquid-propellant engines; reliability of solid-propellant motors; reliability of liquid-propellant engines, and other topics.

SCIENTIFIC MANPOWER 1961. Washington, National Science Foundation, 1962. 30 p. (NSF 62–22.)

Selected papers delivered at the 1961 Annual Meeting of the American Statistical Association and the American Association for the Advancement of Science. The papers are: THREE YEARS AFTER THE HOUSE COMMITTEE REPORT ON SCIENTIFIC AND TECHNICAL PERSONNEL DATA, by Thomas J. Mills; PERIODIC ESTABLISHMENT SURVEYS OF EMPLOYMENT IN SCIENCE AND ENGINEERING, by Robert W. Cain; STUDIES OF DEMAND FOR SCIENTIFIC AND TECHNICAL PERSONNEL, by Harold Goldstein; CENSUS-RELATED STUDIES OF SCIENTIFIC AND TECHNICAL PERSONNEL, by Seymour Warkov; and ENGINEERING AND SCIENCE—A STRUGGLE FOR SURVIVAL, by Truman H. Kuhn.

SPACE AND NATIONAL SECURITY . . . . SYMPOSIUM AT LAS VEGAS, in *Air Force*, v. 45, no. 11 (Nov 1962) 62–74 plus.

A highlight of the 1962 Air Force Association Convention was the following Symposium on Space and National Security: Can we afford Medieval Thinking in the Space Age? by Howard W. Cannon; Space—Newest Arena for Military Break-Throughs, by Arthur Kantrowitz; Meeting the Potential Soviet Threat from Space, by Air Marshal C. Roy Sleman; Space Dollars, Sense, and Defense, by Edward C. Welsh; USAF's Job in Space, by Gen. Bernard A. Schriever.

SPACE RESEARCH II, ed. by H. C. vande Hulst. Amsterdam, North-Holland Publishing Co., 1961. 1241 p.

Proceedings of the Second International Space Science Symposium, held in Florence, Italy, April 10–14, 1961, which was organized by The Committee on Space Research—COSPAR and Consiglio Nazionale Delle Ricerche. About 250 scientists from all countries in the world attended. "The symposium illustrated again that it is both desirable and possible to maintain a worldwide co-operation in man's efforts towards the exploration of space." Part I: OPTICAL TRACKING AND PREDICTION SERVICE; Part II: RADIO TRACKING; Part III: DYNAMICS OF SATELLITE MOTION; Part IV: TELEMETRY AND DATA RECOVERY; Part V: RECENT RESULTS FROM INSTRUMENTED SATELLITES AND SPACE CRAFT; Part VI: WORLD MAGNETIC SURVEY; Part VII: SPECIAL EVENTS; Part VIII: REFERENCE ATMOSPHERE; Part IX: RESEARCH BY MEANS OF SOUNDING ROCKETS.

THE WORK OF THE CCIR IN THE FIELD OF SPACE COMMUNICATIONS, by I. Ranzi, in *Signal*, v. 17, no. 1 (Sept 1962) 19–21 plus.

The International Radio Consultative Committee's Study Group IV on Space Communications held its first meeting in Washington from 12 to 23 Mar. 1962. It was an interim meeting

to prepare the Plenary Assembly of the CCIR scheduled for New Delhi in Jan., 1963. A series of documents was arranged concerning questions, study programs, reports and recommendations in draft, to be submitted to the Plenary Assembly for its final approval. A list of discussed subjects is presented by the author, with some summarizations of conclusions: factors affecting the selection of frequencies for telecommunication with and between space vehicles; technical characteristics of communication systems using Earth satellites as active or passive repeaters; technical characteristics of Earth-space links; space service antennae; sharing of the radio-frequency spectrum with other services; protection of frequencies used for radio-astronomical measurements; experimental communication satellite program in the US; and preliminary views of USSR on frequency allocation for space services.

F. Dictionaries and Glossaries.

ASTRONOMICAL DICTIONARY, by Josip Kleczek. New York, Academic Press, 1961. 972 p.

This dictionary contains terms in English, Russian, German, French, Italian and Czech. The dictionary consists of two parts. In the first part the terms are devided systematically into 34 sections, while the second parts is an alphabetical index for each of the six languages. Among the terms covered: astronautics, radioastronomy, cosmology, astrophysics, astronomical optics, the planets, et cetera.

ENGLISH-RUSSIAN ARMORED VEHICLES DICTIONARY. Anglo-Ruskii avtobronetankovyi slovar' comp. by A. P. Chochia and A. S. Shcheglov. Moscow, Voennoe Izdatel'stvo Oborony SSSR, 1961. 783 p.

Contains more than 30,000 words mainly of American and British armor/artillery terminology including that which deals with rockets.

ENGLISH-RUSSIAN DICTIONARY ON ANTIAIRCRAFT AND ANTIMISSILE DEFENSE. Anglo-russkii slovar' po protivovozdushnoi i protivoraketnoi oborone, ed. by Col. A. V. Baranov. Moscow, Voennoe Izdatel'stvo Ministerstva Oborony SSSR, 1961. 720 p.

The dictionary is the first systematic listing of English-language terms dealing with antiaircraft and antimissile defense and is intended for those engaged in translation of materials from English into Russian. The dictionary includes the terms most commonly used in organization, equipment, tactics, operation, combat preparedness, and daily AA defense activities and Civil Defense activities of USA and England. Appendices include detailed drawings and nomenclature of various types of missiles (land, water, and air) and launching installations.

ENGLISH-RUSSIAN DICTIONARY ON AVIATION AND ROCKET BASES. Anglo-Rsskii Slovar' po aviatsionnym i raketnym bazam, comp. by S. M. Nikitin and Iu. I. Khruchchev. Moscow, Viennoe Izdatel'stvo Ministerstva Oborony Soiuza SSR, 1962. 355 p.

Contains more than 8,000 words dealing with construction and utilization or airports and rocket bases. The terminology is based on that employed in USA, Gt. Britain, or the Armed Forces of NATO. Appendixes include a listing of the names and location of some of the US domestic and overseas air bases as well as those of other Western Powers.

A MISSILE AND SPACE GLOSSARY, in *Air Force*, v. 45, no. 4 (April 1962) 143 plus.

"From 'ablation' to 'zodiacal bond,' the world of aerospace has a special language. Herewith a wide-ranging glossary of aerospace terminology, plus a listing of designations of US space projects—MERCURY, DYNA-SOAR, APOLLO, GEMINI, and the rest."

RUSSIAN-ENGLISH CHEMICAL AND POLYTECHNICAL DICTIONARY, by Ludmilla Ignatiev Callaham. 2d ed., New York, John Wiley, 1962. 892 p.

Includes terminology employed in rocketry.

SHORT GLOSSARY OF SPACE TERMS. Washington, National Aeronautics and Space Administration, Office of Scientific and Technical Information, March 1962. 57 p.

This booklet is intended to be an authoritative compilation of brief definitions of technical terms frequently used by space technologists. For expanded definitions of terms see NASA DICTIONARY OF SPACE TERMS.

G. Directories.

SPACECRAFT AND MISSILES OF THE WORLD, 1962, by James Baar and William E. Howard. New York, Harcourt, 1962. 117 p.

In the preface to the book appears the following note: "As for the material on Soviet missiles, it is considered to be the best available in the West outside of the official intelligence community. Relatively little technical information on Soviet missiles and spacecraft has even been released by the Soviet Union."

SPEAKERS' GUIDE FOR SERVICE SPOKESMAN: POWER FOR PEACE: ARMED FORCES DAY, 3D WEEK IN MAY, 1962. Washington, Department of Defense, Office of Public Affairs, 1962. 31 p.

With many references to America's missiles as part of US power for peace.

[34TH ANNUAL DIRECTORY], in *Western Aviation, Missiles and Space*, v. 42, no. 4 (Apr 1962) 136 p.

This directory with a complete index includes the following sections dealing with missiles and rockets: U.S. MISSILES AND ROCKETS; SOUNDING ROCKETS; U.S. LAUNCH VEHICLES; COMPENDIUM OF MISCELLANEOUS PROJECTS; U.S. AEROSPACE CRAFT—MANNED, UNMANNED; FUTURE SATELLITE PROGRAMS; U.S. SATELLITE STATISTICS; and TARGET MISSILES AND SURVEILLANCE DRONES.

WORLD SPACE DIRECTORY, ed. by Donald W. Dean. Washington, American Aviation Publications, 1962. 380 p.

Lists U.S. and foreign missile/space companies, officials and government agencies.

H. Encyclopedias and Yearbooks.

THE AEROSPACE YEAR BOOK 1962. Washington, American Aviation Publications, 1962. 484 p.

A pictorial display of the highlights of aerospace progress during the calendar year 1961; the aerospace industry in 1961; military aerospace operations (a survey of the operations of the nation's military services during 1961); a review of the major government research and development programs in the aerospace field sponsored by the military services and the National Aeronautics and Space Administration; a pictorial round-up and status report on the weapons which make up the US missile arsenal; 1961 day by day chronology of the major aerospace events; a historical summary of the mile-stones of American aerospace progress from the first balloon ascents of 1784 through 1961; and a compilation of official records established or claimed in the US during 1961 as reported by NASA.

[4TH ANNUAL MISSILE AND SPACE ALMANAC], in *Air Force and Space Digest*, v. 46, no. 4 (Apr 1963) 33–161.

The first section of this issue reports the views of top Air Force leaders on the challenges to the country and the Air Force in the space-age cold war. The second section represents an analytical view of current national space policy. The next section covers the broad subject of the relation of technology to politics in the context of the US-Soviet confrontation. The final section carries the space-age reference handbook. Contents: THE SPACE AGE IN PERSPECTIVE; SPACE AND THE COLD WAR, by the Hon. Eugene M. Zuckert; KEEPING SPACE FREE, by Gen. Curtis E. LeMay; NEEDED—MILITARY "STICK TIME" IN SPACE, by Lt. Gen. James Ferguson (The Air Force must attain not only technological capabilities but also systems and operational experience in the space regime.); BUILDING BLOCKS . . . . BUT NO BUILDING, by J. S. Butz, Jr. (The "bits and pieces" approach, with little effort to build a viable military space program, seems to be current Pentagon style.); THE ACB'S OF SPACE BUILDING BLOCK; USAF CONTRIBUTIONS TO THE NASA EFFORT, by William Leavitt; USAF'S SPACE AGE VETERANS, by Allan B. Scholen; CONGRESS TAKES SECOND LOOK AT SPACE AND NATIONAL DEFENSE, by Claude Witze; HALTING THE INFLATIONARY SPIRAL OF DEATH, by Ivan A. Getting (Tomorrow's casualties can be prevented only by a continuing credible deterrent policy that makes war suicidal for the aggressor.); SPACE TECHNOLOGY — TODAY'S TOOL FOR CONTROLLED SPACE, by William Leavitt; UNREALITY AT GENEVA, by David Lilienthal;

AIR FORCE/SPACE DIGEST SATELLITE SCOREBOARD; GALLERY OF MISSILES AND SPACE WEAPONS (USAF, Army, Navy).

SIXTH ANNUAL WORLD MISSILE/SPACE ENCYCLOPEDIA, in *Missiles and Rockets*, v. 11, no. 5 (30 July 1962) 23–145.

The entire issue is devoted to the presentation of the following information: FORECAST FOR FISCAL '63—HOW THE U.S. WILL SPEND $16.2 BILLION ON ITS MISSILE/SPACE PROGRAMS; an illustrated report on U.S. missiles, rockets and space systems—including for the first time engines, drones and sounding rockets, foreign missiles, rockets and satellites, and satellites presently in orbit; DIRECTORY OF CONTRACTORS; and CHRONOLOGY OF MAJOR EVENTS IN FISCAL 1962.

SPECIAL APPENDIX

THE POLITICO-MILITARY ASPECTS OF SOVIET MISSILES IN THE CUBAN CRISIS

THE POLITICO-MILITARY ASPECTS OF SOVIET MISSILES IN THE CUBAN CRISIS

WAR OVER CUBA? in *U.S. News and World Report*, v. 53, no. 12 (17 Sept 1962) 37–40 plus.

"Russian military men by thousands, Russian arms in quantity—planes, tanks, missiles, guns—are in the America, based on Cuba, 90 miles from U.S. What now? It may take war to get Russians out. It's a major defeat for the U.S. if they stay." Aside from other uses, Russia could use its new base in Cuba for the following: as a site for stations to monitor and track space shots; as a monitoring site to check on Cape Canaveral, and as a rocket threat to the Cape in case of trouble; and as a potential base for missiles zeroed in on U.S.

KHRUSHCHEV DARES U.S. ON CUBA.... AND—, in *U.S. News and World Report*, v. 53, no. 13 (24 Sept 1962) 43–49.

"Suddenly it's Cuba, not Berlin, where war danger is greatest. Khrushchev threatens to fight if U.S. moves against Castro. Will U.S. move? Not now, says President Kennedy. But he warns: Don't go too far. And U.S. begins a watchful wait." Includes following reports: TO WIN IN CUBA—WHY IT'S A MAJOR JOB NOW; AMERICANS SPEAK UP ON CUBA—"RUN THEM OUT" VS. "NOT YET"; From an Expert—INVASION OF CUBA "IS INEVITABLE."

IS BLOCKADE OF CUBA ON THE WAY? in *U.S. News and World Report*, v. 53, no. 14 (1 Oct 1962) 45–48.

"If the buildup of Soviet power in Cuba continues, blockade by US may be next. Support for such a move is growing. Ships and planes able to do the job already are in the area. Question: would war follow? Experts are studying that now."

IN CUBA: ARMS POUR IN, PRETENSE FALLS AWAY, in *U.S. News and World Report*, v. 53, no. 15 (8 Oct 1962) 44–46.

"One more base, one more step toward open Soviet military occupation—that's the meaning of the 'port' for Russia inside Cuba's fortified Havana Harbor. Next: a rising flow of Soviet arms, equipment and manpower into the island 90 miles from U.S. shores. Naval bases in Cuba fit neatly into Khrushchev's plans for a squeeze on U.S. With "fishing" trawlers and submarines, Soviets can clamp surveillance on U.S. forces never known before in home waters. Castro's pretense about Cuba looks thinner than ever. And a new defense era faces U.S."

CUBA MISSILE THREAT DETAILED, by James Trainor, in *Missiles and Rockets*, v. 11, no. 18 (29 Oct 1962) 12–14.

Thirty-plus operational; MRBM's resembling T–4 in place at bases; cruiser-type IRBM's depicted in drawing. Also included a section on US countermoves. With several aerial photos.

[SPECIAL REPORT ON CUBA], in *Aviation Week and Space Technology*, v. 77, no. 19 (5 Nov 1962) 30–34 plus.

This report consists of the following papers: LATEST PHOTOS SHOW SPEED OF IRBM SITE BUILDUP IN CUBA; CUBAN CRISIS APPEARS FAR FROM SETTLED; KEY EVENTS SINCE CUBAN BLOCKADE NOTICE; KHRUSHCHEV WARNS U.S. ON U–2 FLIGHTS; and LOW-LEVEL PHOTOS PINPOINT CUBAN MISSILE SITES.

THE THREAT, THE MOVES TO MEET IT —KENNEDY'S BROADCAST ON CUBA, in *U.S. News and World Report*, v. 53, no. 19 (5 Nov 1962) 108–110.

Full text of President Kennedy's radio and television address to the nation, as delivered from The White House, 22 Oct. 1962.

THE BIG SHOWDOWN? in *U.S. News and World Report*, v. 53, no. 19 (5 Nov 1962) 35–50.

"It was a dangerous gamble by Khrushchev—sneaking nuclear missiles into Cuba and

aiming them at U.S. Swift action by U.S. checked a further buildup. But real test in a crucial showdown lay ahead. The test: Will Russian missiles be allowed to stay in Cuba: U.S. is determined to get them out, no matter what it takes." Included in this report: Reaction From World Capitals—What's Being Said About U.S. Crackdown on Castro; The Kennedy Doctrine; What Americans Think About "Quarantine" of Cuba; An Expert's Warning on Weapons in Cuba; When Reds Point Missiles at U.S. [This Is the Threat From Cuban Bases], Cuba—A Strong Red Base—The Steps Open to U.S.; Red Missiles in Cuba—Inside Story From Secretary McNamara.

AFTER THE SHOWDOWN ON CUBA . . ., in *U.S. News and World Report*, v. 53, no. 20 (12 Nov 1962) 41–44 plus.

"It was a week of testing and waiting—testing Khrushchev's sincerity; waiting for Soviet missiles to be cleared out of Cuba. When Castro dragged his feet, the U.S. reacted promptly. The big question remained: "What new crisis might have to be faced by Americans if Russia's apparent docility turned into duplicity?" Also included: WHO REALLY GAINED IN THE CUBA SHOWDOWN?

AERIAL PHOTOS SHOW MISSILE ERECTOR REMOVAL AT CUBAN SITES, in *Aviation Week and Space Technology*, v. 77, no. 20 (12 Nov 1962) 30–33.

U.S. MONITORS SHIPS RETURNING RED MRBMS FROM CUBA (PHOTOS), in *Aviation Week and Space Technology*, v. 77, no. 21 (19 Nov 1962) 30–33.

WHAT KIND OF A SOVIET BASE IS CUBA NOW? in *U.S. News and World Report*, v. 53, no. 21 (19 Nov 1962) 83–85.

"The Cuban crisis is by no means over. Instead, even if the Kennedy-Khrushchev agreement goes through, Cuba—like Berlin—will remain a permanent point of crisis. U.S. arms buildup in Florida is a warning to Khrushchev and Castro. Red foot-dragging on getting Russian arms out of Cuba and on meeting U.S. terms may bring war. Peace will permit Khrushchev to keep a Cuban base for subversion and propaganda."

INSIDE STORY ON CUBA . . . . WHY THE U.S. ALMOST GOT CAUGHT, in *U.S. News and World Report*, v. 53, no. 21 (19 Nov 1962) 86–89.

Interview with Senator Kenneth B. Keating.—"Answers to questions now being raised about the Cuban crisis . . . . Senator Keating warned of Soviet missiles on August 31. That was seven weeks before the President ordered a blockade to meet the threat."

THE SCORE IN CUBA NOW, in *U.S. News and World Report*, v. 53, no. 22 (26 Nov 1962) 39–41.

"Tally on the U.S.-Russian showdown over Cuba shows the U.S. ahead—so far. But Khrushchev, his missiles pulled out, stalled on other points. U.S. position: Soviet bombers must go, some inspection must be set up in Cuba. Crisis isn't ended yet."

KENNEDY'S REPORT ON CUBA: THE WORST IS OVER NOW, in *U.S. News and World Report*, v. 53, no. 23 (3 Dec 1962) 83.

Full text of President Kennedy's statement on Cuba made at his news conference in Washington on 20 Nov. 1962.

NEXT ROUND IN CUBA: THE NEW SQUEEZE ON CASTRO, in *U.S. News and World Report*, v. 53, no. 23 (3 Dec 1962) 42–44.

"Getting the Soviet missiles and bombers off the island doesn't end the Cuban crisis. Not for Castro, that is. The squeeze is being tightened on him by U.S. pressure, and it's a squeeze where it hurts most—on his rundown economy. Castro has brought Cuba to the point where it's short of almost everything but guns. The island needs massive help, and it has to come from overseas. U.S. strategy: cut Cuba's supplies at the source, wherever possible. That leaves it to Khrushchev to prop up the place, if he's willing to pay the price."

NEW DEFENSE DEPARTMENT PHOTOS SHOW RAPID DISASSEMBLY OF SOVIET MISSILE SITES IN CUBA, in *Aviation Week and Space Technology*, v. 78, no. 7 (18 Feb 1963) 54–57.

RECON PHOTOS REVEAL SOVIET ANTI-AIRCRAFT BUILDUP IN CUBA, in *Aviation Week and Space Technology*, v. 78, no. 7 (18 Feb 1963) 28–31.

CUBA: HOW DANGEROUS NOW, in *U.S. News and World Report*, v. 54, no. 7 (18 Feb 1963) 58–63.

"The administration's story of the Soviet buildup in Cuba. Photographs and facts now officially disclosed show how Khrushchev turned the island into a Soviet armed camp; how he still maintains there the most formidable military base in the Hemisphere outside the U.S. itself." Includes the CIA's report of Soviet power in Cuba.

CUBA: THOUGHTS PROMPTED BY THE CRISIS, by Charles Burton Marshall. Washington, Washington Center of Foreign Policy Research, 1962. 23 p.

This brochure contains three articles which were published in The New Republic for 1 Oct. and 10 and 24 Nov. 1962, reflecting on foreign policy prompted by "recent events regarding Cuba." Contents: WHY THE RUSSIANS ARE THERE; AFTERTHOUGHTS ON THE BLOCKADE; and HIDE AND SEEK—DOUR THOUGHTS ON INSPECTION.

THE CUBAN CRISIS: A DOCUMENTARY RECORD. New York, Foreign Policy Association, 1963. 84 p. (Headline Series Number 157.)

"The establishment of Soviet missile bases in Cuba produced the most potentially dangerous threat to peace in the postwar period. For a few days last October the United States and the U.S.S.R. seemed close to an armed confrontation. As this Headline Series . . . . [went] to press the crisis . . . . [appeared] to have been peacefully resolved. A definitive appraisal of its impact and implications must doubtless await the passage of time. But for any assessment, the significant documents that recorded the development of the crisis are indispensable. These documents are brought together in this Headline Series. They cover in chronological order the period from September 2 to the climactic phase of the crisis—the weekend of October 27–28, when the basis for a negotiated solution was finally reached."

STRIKE IN THE WEST, by James Daniel and John G. Hubbell. New York, Holt, Rinehart and Winston, 1963. 180 p.

This book on last October's missile showdown in Cuba "puts new light on the entire affair. The authors trace the buildup, the first hints of it, the verification by U.S. intelligence, and tell how top officials reacted to the danger." How was it possible for Khrushchev to sneak a mighty arsenal of nuclear missiles into Cuba without getting caught in the act? Were US officials really unaware of what was under way in the days that built to a crisis? See also: 90 DANGEROUS DAYS, in U.S. News and World Report, v. 54, no. 10 (11 Mar 1963) 70–72, which discusses the book.

APPENDIX A

RUSSIA'S MISSILES AND SPACE BOOSTERS

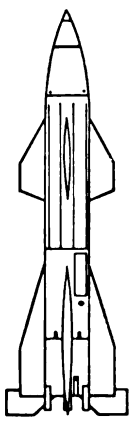
SOVIET INTELLIGENCE REPORT

Reprinted by the Department of the Army with the permission from AEROSPACE MANAGEMENT magazine, March 1962 issue.

Russia's Missiles and Space Boosters

Two areas in which Russia has had profound success have been cloaked in secrecy: propulsion and guidance. Some of the claims, by U. S. intelligence, about the dearth of information are legitimate, others are mythical. Aerospace Management has worked for two years assembling data on Russia's missile arsenal. The findings of these studies are summarized in the following nine pages. This is the first complete description of . . .

WHAT THE SOVIETS HAVE . . .



C-2

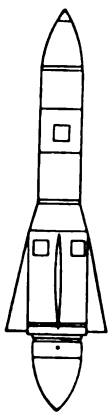
Service: Air Force
Type: Surface-to-Air
Status: Training, phased out

Physical Data

Length: 25.8 ft
Diameter: 2.95 ft, 8.1 ft fin span
Weight: 8400 lb
Powerplant: Liquid engine, 17,160-lb thrust
Warhead: High-explosive—675 lb
Guidance: Beam rider

Remarks

Range 25 mi at Mach 2.0. Ceiling 50,000 ft. Developed from WW II German "Wasserfall."



GOLEM 2

Service: Navy
Type: Underwater-to-Surface IRBM
Status: Operational

Physical Data

Length: 56.9 ft
Diameter: 7.2 ft, 13.2 ft fin span
Weight: 74,800 lb
Booster: Liquid engine, 242,000-lb thrust
Sustainer: Liquid engine, 71,500-lb thrust
Warhead: 1430 lb high-explosive or nuclear
Guidance: Programmed

Remarks

Range 1240 mi at Mach 11.4. Three missiles towed behind submerged submarine. Missile stands upright in water by flooding ballast chamber in tail.

GOLEM 1

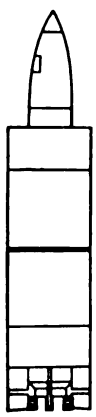
Service: Navy
Type: Underwater-to-Surface
Status: Operational

Physical Data

Length: 53.8 ft
Diameter: 5.5 ft, 11.2 ft fin span
Weight: 33,125 lb
Powerplant: Liquid engine, 121,200-lb thrust
Warhead: 2000 lb high-explosive or nuclear
Guidance: Programmed

Remarks

Range 395 mi at Mach 7.0. Two or three towed behind submerged submarine. Missile stands upright in water by flooding ballast chamber in tail.



GOLEM 3

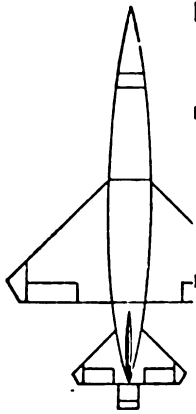
Service: Navy
Type: Underwater-to-Air
Status: Operational-development

Physical Data

Length: 17.2 ft
Diameter: 2.2 ft, 5.9 ft span
Weight: 4625 lb
Powerplant: Four solid propellant, 14,950-lb total thrust
Warhead: 175 lb high-explosive
Guidance: Infrared

Remarks

Range 7.5 mi at Mach 2.5. Ceiling 67,000 ft. Launched from tube by compressed air. Land version in development stage for Army.



HOUND DOG Type

Service: Air Force
Type: Air-to-Surface
Status: Operational

Physical Data
Length: 33.0 ft
Diameter: 3.0 ft
Wing Span: 18.0 ft
Weight: Unknown
Powerplant: Turbo-jet engine
Warhead: Nuclear
Guidance: Radar

Remarks
Range 250 to 300 mi at Mach 1.75. First shown at the 9 July 1961 Tushino Air Show. Missile, painted red, was mounted in the bomb bay of a modified TU-16 Badger medium bomber.

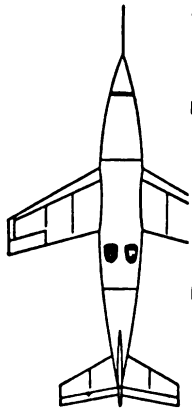
Configuration not available

KOMET (Medium Range Type)

Service: Air Force
Type: Air-to-Surface
Status: Operational

Physical Data
Length: 52.0 ft
Diameter: 6.0 ft
Wing Span: 24.0 ft
Weight: Unknown
Powerplant: Solid
Warhead: Nuclear
Guidance: Radar

Remarks
Range 300 mi at Mach 2.0. First shown at the 9 July 1961 Tushino Air Show. Missile was painted red with a white radome nose and was mounted in the bomb bay of a modified TU-20 Bear turboprop bomber.

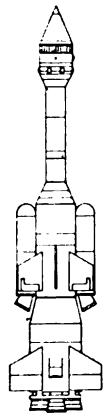


J-3

Service: Navy
Type: Surface-to-Surface IRBM
Status: Operational

Physical Data
Length: 37.2 ft
Diameter: 4.6 ft, 23.7 ft wing span
Weight: 20,900 lb
Booster: Four solid propellant, 4000-lb total thrust
Sustainer: Ram jet, 14,900-lb thrust
Warhead: 2200 lb nuclear
Guidance: Radio/programmed

Remarks
Range 1450 mi at Mach 1.15. Used from at least 7 submarines. Also used from cruiser type vessels.

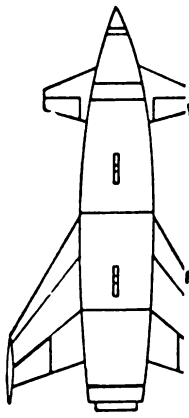


LUNIK I Booster

Service: USSR Academy of Science
Type: Space Booster
Status: In use

Physical Data
Length: 123.0 ft
Diameter: 24.0 ft
Fin Span: 28 ft
Weight: 436,000 lbs; payload—3245 lb
Powerplant: Booster—3 liquid engines, 480,000 lb total thrust. 2 solid motors attached, 198,000 lb total thrust. 2nd Stage—2 liquid engines, 270,000 lb total thrust. 3rd Stage—One liquid engine, 78,100 lb thrust.
Guidance: Inertial

Remarks
Launched 2 Jan 1959. Vehicle composed of a modified T-3 Mark 2 ICBM, with two additional T-10 IRBM solid booster rockets of 99,000 lb thrust each attached to the second stage.

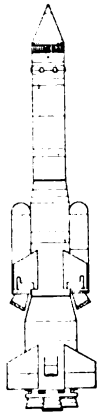


KOMET D

Service: Air Force
Type: Air-to-Surface
Status: Development

Physical Data
Length: 15.0 ft
Diameter: 3.0 ft, 8.0 ft wing span
Weight: Unknown
Powerplant: Solid propellant, 3000 to 5000-lb thrust
Warhead: HE or Nuclear
Guidance: Radio-radar

Remarks
Range 93 mi at Mach 1.1. Flight tested in 1957. Launched at 50,000 ft altitude from BISON or BEAR bomber.

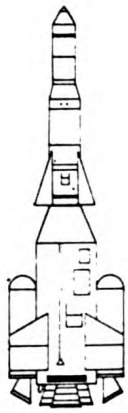


LUNIK II Booster

Service: USSR Academy of Science
Type: Space Booster
Status: In use

Physical data
Length: 123 ft
Diameter: 24 ft
Fin Span: 28 ft
Weight: 437,000 lb; payload—858.4 lb
Powerplant: Booster—3 liquid engines, 480,000 lb total thrust. 2 solid rocket motors attached, 198,000 lb total thrust. 2nd Stage—2 liquid engines, 270,000 lb total thrust. 3rd Stage—One liquid engine, 78,100 lb thrust.
Guidance: Inertial

Remarks
Launched 12 Sept 1959. Impacted on Moon 14 Sept 1959. Vehicle is composed of a modified T-3 Mark 2 ICBM with two T-10 IRBM booster rockets of 99,000 lb thrust each attached.



LUNIK III Booster

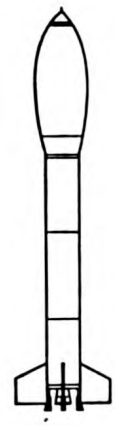
Service: USSR Academy of Science
Type: Space Booster
Status: In use

Physical Data

Length: 105 ft
Diameter: 30 ft
Fin Span: 30 ft
Weight: 352,000 lb; load—614 lb
Powerplant: Booster — 4 liquid engines; 570,000 lb total thrust. 2 solid motors attached, 176,000 lb total thrust. 2nd Stage — One liquid engine, 268,000 lb thrust. 3rd Stage—Solid, 99,600 lb thrust.
Guidance: Programmed/inertial

Remarks

Launched 4 Oct 1959. Booster is a T-3A Mark 2 modified with additional fins for stability; two modified T-10 IRBM solid rockets of 88,000 lb thrust each are attached. 2nd stage is a modified T-2 IRBM with the M-103 engine. 3rd stage is a modified T-10 IRBM of 99,600 lb thrust.



M-100A

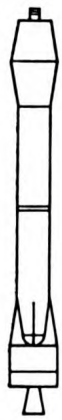
Service: Air Force
Type: Air-to-Air
Status: Operational

Physical Data

Length: 4.43 ft
Diameter: 0.26 ft, 1.0 ft fin span
Weight: 85 lb
Powerplant: Solid propellant 1000-lb thrust
Warhead: 20 lb high-explosive
Guidance: Infrared

Remarks

Range 3.4 to 5 mi at Mach 2.65. Control is by jet deflection. Also in an unguided version. Similar to GAR-3 "Falcon."



ME(IGOR)

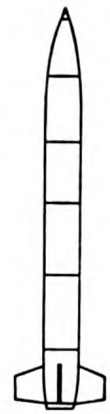
Service: Army
Type: Anti-tank
Status: Operational

Physical Data

Length: 4.0 ft
Diameter: 0.41 ft
Weight: 10.5 lb
Powerplant: Solid propellant
Warhead: 3.75 lb high-explosive
Guidance: None

Remarks

Range 2.25 mi at Mach 0.7. Two man firing team. Similar to U. S. "Bazooka." In production since 1946. Used throughout the Soviet Armed Forces.



POL-1 and POL-2

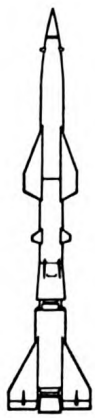
Service: Air Force
Type: Target missile
Status: Operational-development

Physical Data

Length: (1) 14.27 ft, (2) 25.6 ft
Diameter: (1) 0.92 ft, (2) 2.3 ft
Weight: (1) 2400 lb, (2) 25,950 lb
Powerplant: Four solid propellant (1) 7990 lb total thrust (2) 90,650 lb total thrust
Payload: (1) 9.2 lb, (2) 90 lb
Guidance: (1) Programmed, (2) Inertial programmed

Remarks

POL-2 designed for IGY studies Recovered by means of a parachute in nose cone.



M-2

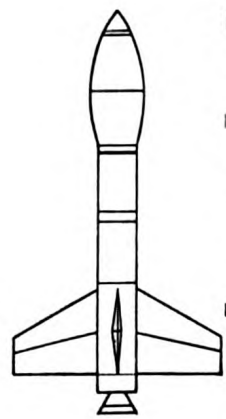
Service: Air Force, Army
Type: Surface-to-Air
Status: Operational

Physical Data

Length: 25.0 ft
Diameter: 1.6 ft, 5.3 ft fin span
Weight: 3970 lb
Booster: Solid, 9350-lb thrust
Sustainer: Solid, 4625-lb thrust
Warhead: 26.5 lb high-explosive
Guidance: Semi-active homing

Remarks

Range 37.25 mi at Mach 2.3. Ceiling 68,640 ft. First seen in 1957 in Moscow. Mounted on mobile trailer-launcher. New test version reported to reach 150,000 ft.



RS-132A

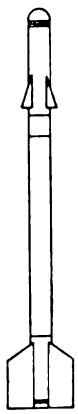
Service: Navy
Type: Air-to-surface
Status: Operational

Physical Data

Length: 3.8 ft
Diameter: 0.45 ft
Fin Span: 2.0 ft
Weight: Unknown
Power Plant: Solid propellant rocket motor
Warhead: High explosive
Guidance: None

Remarks

Velocity Mach 1.2. Shown at the 9 July 1961 Tushino Air Show mounted on the new Ka-19 helicopter. To be used in an anti-submarine warfare role.



SIDEWINDER Type

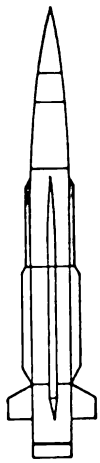
Service: Air Force
Type: Air-to-air
Status: Operational

Physical Data

Length: 9.0 ft
Diameter: 0.67 ft
Fin Span: 1.75 ft
Weight: 175 lb
Power Plant: Solid propellant
Warhead: High explosive
Guidance: Infra-red

Remarks

Range 2 to 3 mi at Mach 2.5. Reported to have been used to down a USAF RB-47 bomber over the Barents Sea on 1 July 1950. Has been in production since May 1960.



SKY BOLT Type

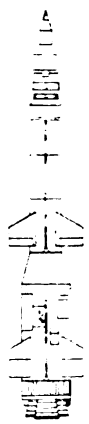
Service: Air Force
Type: Air-to-surface
Status: Development

Physical Data

Length: 30.0 ft
Diameter: 5.0 ft
Fin Span: 8.0 ft
Weight: Unknown
Power Plant: Two-stage solid
Warhead: Nuclear
Guidance: Radar

Remarks

Range 500 mi at Mach 2.5. First shown at the 9 July 1961 Tushino Air Show mounted in the bomb bay of the new Tupovlev designed Blinder bomber.



SPACE VEHICLE 1, 2, 3, 4, 5

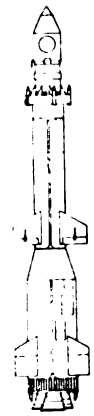
Service: USSR Academy of Science
Type: Space Booster
Status: In use

Physical Data

Length: 127 ft
Diameter: 16 ft
Fin Span: 24 ft
Weight: 700,000 lb (est); Pay load—1—9,988 lb; 2—10,140 lb; 3—10,039 lb; 4—10,362 lb; 5—10,329 lb
Power Plant: Booster—4 liquid engines, 820,000 lb total thrust
2nd Stage—2 liquid engines, 268,000 lb total thrust
Guidance: Programmed
Velocity: Mach 21.5 at burn out

Remarks

Launchings: Space vehicle 1, 15 May 1959; 2, 19 Aug 1960; 3, 1 Dec 1960; 4, 9 Mar 1961; 5, 25 Mar 1961. All vehicles carried dogs and other animal life forms for pre man-in-space shots.



SPACE VEHICLE 6

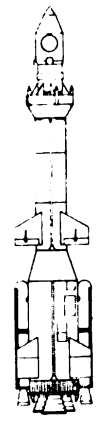
Service: USSR Academy of Science & Missile Command
Type: Space Booster
Status: In use

Physical Data

Length: 137 ft
Diameter: 16 ft
Fin Span: 24 ft
Weight: 850,000 lb (est); payload—10,395 lb
Power Plant: Booster—4 liquid engines, 820,000 lb total thrust
2nd Stage—2 liquid engines, 268,000 lb total thrust
Guidance: Programmed
Velocity: Mach 21.5 at burn out

Remarks

Launched 12 April 1961. Major Yuri Gagarin made one orbit in the Vostok I spacecraft. Launch site—Baykonur; Landing site—Smelovka in the Saratov region. Vehicle was a modified T-3A Mark 2 ICBM.



SPACE VEHICLE 7

Service: USSR Academy of Science and Missile Command
Type: Space Booster
Status: In use

Physical Data

Length: 137 ft
Diameter: 25 ft (Over booster rockets)
Fin Span: 24 ft
Weight: 880,000 lb (est); payload—10,408 lb
Power Plant: Booster—4 liquid engines; 820,000 lb total thrust. 2 solid motors attached; 132,000 lb total thrust
2nd Stage—2 liquid engines, 268,000 lb total thrust
Guidance: Programmed
Velocity: Mach 22 at cut off

Remarks

Launched 6 Aug 1961. Major Gherman Titov made 17 orbits in the Vostok II spacecraft. Launch site, Baykonur; landed, Saratov area.

SPUTNIK I Booster

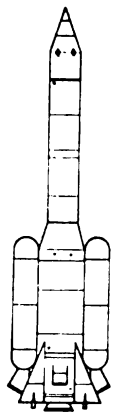
Service: USSR Academy of Science
Type: Satellite Launcher
Status: In use

Physical Data

Length: 105 ft; Diameter: 12.2 ft
Fin Span: 14 ft
Weight: 156,000 lb, payload—183.9 lb
Power Plant: Booster—3 liquid engines, 181,950 lb total thrust. 4 solids attached, 88,000 lb total thrust: 2nd Stage—One liquid engine; 78,100 lb thrust: 3rd Stage—One solid
Guidance: Booster—Radio/Inertial
2nd Stage—Inertial
Velocity: Mach 27.6 at cut off

Remarks

Launched 4 Oct 1957. Entire vehicle built of existing hardware.



SPUTNIK II Booster

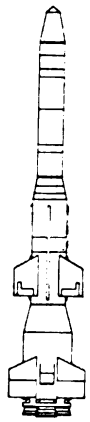
Service: USSR Academy of Science
Type: Satellite Launcher
Status: In use

Physical Data

Length: 79 ft
Diameter: 17.5 ft
Fin Span: 17 ft
Weight: 165,118 lb; payload—1118.2 lb
Power Plant: Booster—M-103 liquid engine, 268,000 lb thrust. Two T-9 solid motors attached, 106,500 lb total thrust: 2nd Stage—One liquid engine, 78,100 lb thrust: 3rd Stage—Solid
Guidance: Inertial

Remarks

Launched 3 Nov 1957. Vehicle composed of existing hardware: Booster—Modified T-2 IRBM booster with two T-9 (KOMET I) solid rocket motors attached; 2nd stage—Modified T-1 IRBM; 3rd stage—unidentified solid rocket motor.



SPUTNIK III Booster

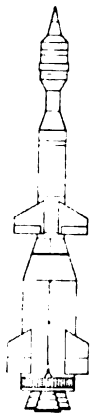
Service: USSR Academy of Science
Type: Space Booster
Status: In use

Physical Data

Length: 118 ft
Diameter: 14 ft
Fin Span: 22 ft
Weight: 180,000 lb; load—2925.5 lb
Power Plant: Booster—3 liquid engines; 480,000 lb total thrust
2nd Stage—2 liquid engines; 270,000 lb total thrust
3rd Stage—One liquid engine; 78,100 lb thrust
Guidance: Radio/inertial
Velocity: Mach 28.1 at cut off

Remarks

Launched 15 May 1958. Vehicle used was a modified T-3 Mark 1 (M 104) ICBM. The Soviet Missile Command participated in this launch with the first ICBM used in space exploration.



SPUTNIK VII Booster

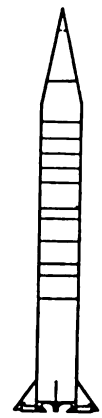
Service: USSR Academy of Science
Type: Space Booster
Status: In use

Physical Data

Length: 113 ft
Diameter: 16 ft
Fin Span: 24 ft
Weight: 680,000 lb; payload—14,293 lb
Power Plant: Booster—4 liquid engines; 820,000 lb total thrust
2nd Stage—2 liquid engines; 268,000 lb total thrust
3rd Stage—Solid, 22,000 lb thrust
Guidance: Programmed
Velocity: Mach 22.0 at cut off

Remarks

Launched 4 Feb 1961. Believed to have been first Venus Probe of which the 3rd stage failed to ignite. Vehicle is a modified T-3A Mark 2 ICBM with a modified T-5B solid rocket motor as 3rd stage attached to satellite.



T-1 (M 101)

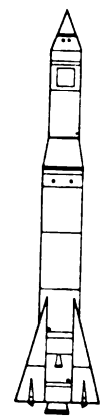
Service: Army, Navy
Type: Surface-to-Surface IRBM
Status: Operational

Physical Data

Length: 62.0 ft
Diameter: 5.6 ft, 12.0 ft fin span
Weight: 37,850 lb
Powerplant: Liquid engine 77,000-lb thrust
Warhead: 2650 lb nuclear
Guidance: Radio-inertial

Remarks

Range 400 to 600 mi. First seen in 1956 in Moscow. Copy of German A-4. Has transporter-erector trailer. Reports of over 3000 in use. Few given to Red China. Some versions use uprated engine of 78,100 lb thrust.



T-2 (M 103)

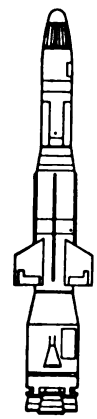
Service: Army
Type: Surface-to-Surface IRBM
Status: Operational

Physical Data

Length: 65.5 ft
Diameter: 8.5 ft, 17.0 fin span
Weight: 122,000 lb
Booster: M-103 liquid engine 268,000-lb thrust
Sustainer: Liquid engine 78,100-lb thrust
Warhead: 2240 lb nuclear
Guidance: Inertial

Remarks

Range 1800 mi at Mach 13.1. Copy of German A-10. Based in Satellite countries. Reports of 700 in service. Components used in Sputnik shots.



T-3 Mk 1 (M 104)

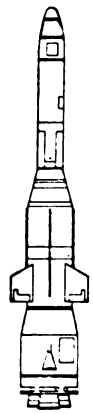
Service: Soviet Missile Command
Type: Surface-to-Surface ICBM
Status: Operational

Physical Data

Length: 88.5 ft
Diameter: 11.5 ft, 19.5 ft fin span
Weight: 176,000 lb
Booster: Three liquid engines, 480,000-lb total thrust
2nd Stage: Two liquid engines, 270,000-lb total thrust
3rd Stage: Liquid, 78,100-lb thrust
Warhead: 2200 lb thermonuclear
Guidance: Radio-inertial

Remarks

Range 4950 mi at Mach 20.0. In operational service 1959. Guidance housed in second stage. Production stopped.



T-3 Mk 2

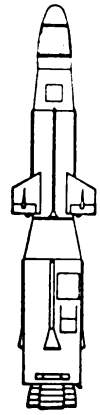
Service: Soviet Missile Command
Type: Surface-to-Surface ICBM
Status: Development

Physical Data

Length: 108.0 ft
Diameter: 16.0 ft, 23.5 ft fin span
Weight: 352,000 lb
Booster: Three liquid engines, 480,000-lb total thrust
2nd Stage: Two liquid engines, 270,000-lb total thrust
3rd Stage: Liquid engine, 78,100-lb thrust
Warhead: 2500 lb thermonuclear
Guidance: Inertial

Remarks

Range 6500 mi at Mach 20.7. First launched in 1957. Guidance in second stage. Used for launching satellites into space. Production stopped.



T-3A Mk 1

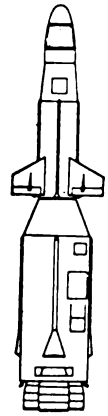
Service: Soviet Missile Command
Type: Surface-to-Surface ICBM
Status: Operational

Physical Data

Length: 91.5 ft
Diameter: 12.0 ft, 19.5 ft fin span
Weight: 176,000 lb
Booster: Four Liquid engines, 570,000 lb total thrust
Sustainer: Two liquid engines, 268,000-lb total thrust
Warhead: 1100 lb thermonuclear
Guidance: Programmed

Remarks

Range 6200 mi at Mach 21.5. Advance T-3 missile, using many T-3 component parts. Vernier engines for roll and directional control. Fired from fixed bases. In production and being considered for "hardened sites."



T-3A Mk 2

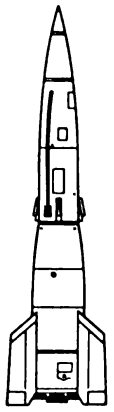
Service: Soviet Missile Command
Type: Surface-to-Surface ICBM
Status: Operational

Physical Data

Length: 101.5 ft
Diameter: 16.0 ft, 23.5 ft fin span
Weight: 396,000 lb
Booster: Four liquid engines, 820,000-lb total thrust
Sustainer: Two liquid engines, 268,000-lb thrust
Warhead: 1250 lb thermonuclear
Guidance: Programmed

Remarks

Range 6800 mi at Mach 22.1. Also in mass production. Fired from fixed bases. Reports that this version was used for the Soviet "man-in-space" project.



T-4 (M 102)

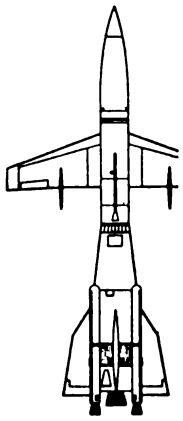
Service: Army
Type: Surface-to-Surface IRBM
Status: Phased out

Physical Data

Length: 56.1 ft
Diameter: 7.2 ft, 14.0 ft fin span
Weight: 70,850 lb
Booster: Three liquid engines, 181,950-lb total thrust
Sustainer: Liquid engine 52,800-lb thrust
Warhead: 1775 lb high-explosive
Guidance: Inertial

Remarks

Range 1000 mi at Mach 11.15. Developed from German A-10. Very elaborate guidance. Has not been too successful. Components used as booster for some Sputnik shots.



T-4A

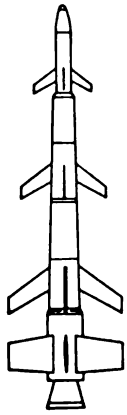
Service: Soviet Missile Command
Type: Surface-to-Surface ICBM
Status: Development

Physical Data

Length: 122.0 ft
Diameter: 10.2 ft, 63.8 ft wing span
Weight: 231,000 lb
Booster: Four solid propellant, 264,000-lb total thrust
2nd Stage: Liquid engine, 264,000-lb thrust
3rd Stage: Liquid engine, 77,000-lb thrust
Warhead: 3080 lb nuclear
Guidance: Radio-programmed

Remarks

Range 12,500 mi at Mach 19.5. Existence confirmed December 1957. Soviet version of the German Sanger Project of anti-podal rocket-bomber. Involved Soviet "man-in-space" projects.



T-5

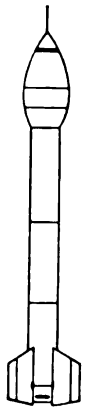
Service: Army
Type: Surface-to-Surface
Status: Training, phased out

Physical Data

Length: 32.2 ft
Diameter: 2.8 ft, 9.4 fin span
Weight: 4850 lb
Booster: Liquid engine, 83,500-lb thrust
2nd Stage: Solid propellant, 8200-lb thrust
3rd Stage: Solid propellant, 2300-lb thrust
4th Stage: Solid propellant, 440-lb thrust
Warhead: 458 lb high-explosive
Guidance: None

Remarks

Range 100 mi at Mach 4.35. Ceiling 65,000 ft. Identified in 1948. Copy of German "Rheinbote" design. Also used as surface-to-air missile.

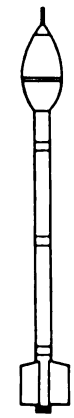


T-5B

Service: Army
Type: Surface-to-Surface
Status: Operational

Physical Data
Length: 30.0 ft
Diameter: 2.5 ft, 5.0 ft fin span
Weight: 5750 lb
Powerplant: Solid propellant, 22,000-lb thrust
Warhead: 1180 lb high-explosive or nuclear
Guidance: None

Remarks
Range 25 mi at Mach 2.3. First seen in 1957. Mounted on KW-85 or Joseph Stalin II AFV tank chassis. Standard in all Soviet Armored Units.

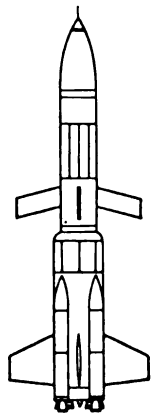


T-5C

Service: Army
Type: Surface-to-Surface
Status: Operational

Physical Data
Length: 25.0 ft
Diameter: 1.1 ft, 2.1 ft fin span
Weight: 4400 lb
Powerplant: Solid propellant, 23,200-lb thrust
Warhead: 1100 lb high-explosive or nuclear
Guidance: None

Remarks
Range 25 mi at Mach 3.3. Introduced in November 1957. Mounted on PT-76 amphibian tank chassis. Very mobile. New version with different shaped warhead now in production.

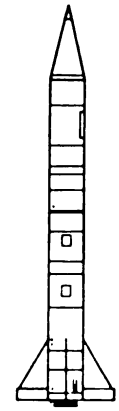


T-6

Service: Air Force, Army
Type: Surface-to-Air
Status: Operational

Physical Data
Length: 22.0 ft
Diameter: 28 ft, 5.2 fin span
Weight: 3950 lb
Booster: Four solid propellant, 10,580-lb total thrust
Sustainer: Two solid propellant, 2200-lb thrust
Warhead: 88 lb high-explosive
Guidance: Radar

Remarks
Range 25 mi at Mach 2.4. Ceiling 62,000 ft. Finned nose cone separated by explosive bolts and warhead coasts to target on ballistic trajectory. In wide use, claimed highly efficient for air defense.

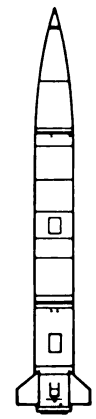


T-7

Service: Air Force
Type: Surface-to-Air
Status: Operational

Physical Data
Length: 30.1 ft
Diameter: 2.6 ft, 9.1 ft fin span
Weight: 5050 lb
Powerplant: Two liquid engines, 22,400-lb total thrust
Warhead: 407 lb high-explosive
Guidance: Radar

Remarks
Range 60 mi at Mach 4.4. Ceiling 100,000 ft. Originally a high altitude research vehicle. Produced at an assembly plant near Moscow. Production stopped.

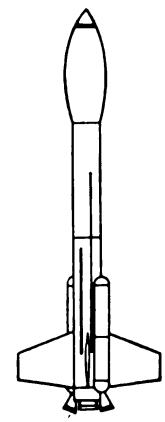


T-7A

Service: Army
Type: Surface-to-Surface
Status: Operational

Physical Data
Length: 27.8 ft
Diameter: 2.7 ft, 9.6 ft fin span
Weight: 8800 lb
Powerplant: Solid propellant 11,450-lb thrust
Warhead: 1770 lb high-explosive or nuclear
Guidance: Radio-inertial

Remarks
Range 100 mi at Mach 4.2. Mounted on KW-85 tank chassis. Launched from vertical position. Very mobile. Comparable to U. S. Army "Corporal" missile.

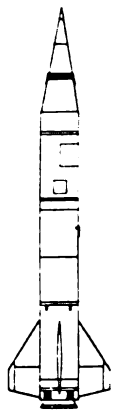


T-8

Service: PVO (Air Force)
Type: Surface-to-Air
Status: Operational

Physical Data
Length: 13.6 ft
Diameter: 1.05 ft, 4.8 ft fin span
Weight: 2090 lb
Booster: Two solid propellant, 4000-lb total thrust
Sustainer: Liquid engine, 4600-lb thrust
Warhead: 50 lb high-explosive
Guidance: Infrared

Remarks
Range 15 to 25 mi at Mach 2.5. Ceiling 79,280 ft. Soviets claim 98 per cent kill rate against J-1 target drones. Deployed in field batteries, six launchers to a battery. Operational since 1954.



T-9 (KOMET 1)

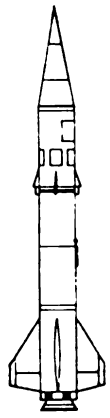
Service: Soviet Missile Command
Type: Surface-to-Surface
Status: Operational

Physical Data

Length: 36.8 ft
Diameter: 4.26 ft, 10.9 ft fin span
Weight: 20,250 lb
Powerplant: Solid propellant 53,250-lb thrust
Warhead: 460 lb high-explosive
Guidance: None

Remarks

Range 102.5 mi at Mach 4.25. Used to test T-10 (KOMET 2) nose cone. Navy launches T-9 from submarines, missiles stored in conning tower. Also identified as CH-17. Said to be in operation with Red China Navy.



T-10 (KOMET 2)

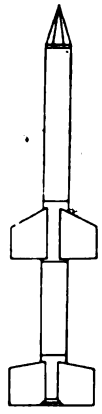
Service: Soviet Missile Command
Type: Surface-to-Surface IRBM
Status: Operational

Physical Data

Length: 42.4 ft
Diameter: 5.9 ft, 10.9 ft fin span
Weight: 41,350 lb
Powerplant: Solid propellant 99,000-lb thrust
Warhead: 550 lb high-explosive
Guidance: Inertial

Remarks

Range 620 mi at Mach 7.5. In production in the USSR and East Germany. Reports of some 3200 KOMET 1 & 2's being produced each month. Used from submarines by the Red Navy.



TYPE 1

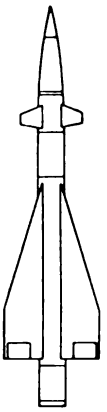
Service: Air Force
Type: Air-to-Air
Status: Operational

Physical Data

Length: 15.0 ft
Diameter: 0.95 ft
Fin Span: 2.5 ft
Wing Span: 2.5 ft
Weight: 1000 lb
Power Plant: Solid propellant, 8700 lb thrust
Warhead: 50-lb high-explosive
Guidance: Infra-red

Remarks

Range 5 plus mi at Mach 2.5. First shown at the 9 July 1961 Tushino Air Show. First of a family of air-to-air missiles similar to the USAF Falcon family.



TYPE 2

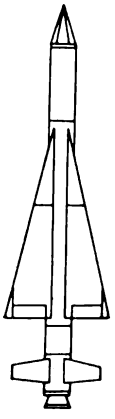
Service: Air Force
Type: Air-to-Air
Status: Operational-development

Physical Data

Length: 15.0 ft
Diameter: 0.95 ft, 2.65 ft wing span
Weight: 1120 lb
Powerplant: Solid propellant 8700-lb thrust
Warhead: 50 lb high-explosive
Guidance: Radar

Remarks

Range 5.5 mi at Mach 2.75. Improved version of the old M-100. Warhead fitted with proximity fuse. Also used for air-to-surface.



TYPE 3

Service: Air Force
Type: Air-to-Air
Status: Operational

Physical Data

Length: 15.0 ft
Diameter: 0.95 ft
Fin Span: 2.5 ft
Wing Span: 3.0 ft
Weight: 1250 lb
Power Plant: Solid propellant, 8750 lb thrust
Warhead: 60-lb high-explosive
Guidance: Infra-red

Remarks

Range 5.5 mi at Mach 3.0. First shown at the 9 July 1961 Tushino Air Show.

Configuration same as Sputnik VII Booster

VENUS BOOSTER

Service: USSR Academy of Science
Type: Space Booster
Status: In use

Physical Data

Length: 113 ft
Diameter: 16 ft
Fin Span: 24 ft
Weight: 680,000 lb; Payload 1416.7 lb
Power Plant: Booster—4 liquid engines; 820,000 lb total thrust
2nd Stage—2 liquid engines; 268,000 lb total thrust
3rd Stage—Solid, 22,000 lb thrust
Guidance: Programmed
Velocity: Mach 22 at cut off

Remarks

Launched 12 Feb 1961. Vehicle was a modified T-3A Mark 2 ICBM, with a modified T-5B solid rocket motor as the 3rd Stage attached to the satellite carrier. Final probe was launched from SPUTNIK VIII.

SUMMARY OF SOVIET MISSILES, ROCKETS, AND BOOSTERS

DESIGNATION	GUIDANCE	POWERPLANT 1st Stage Type	1st Stage lbs T	2nd Stage Type	2nd Stage lbs T	3rd Stage Type	3rd Stage lbs T	SIZE AND PERFORMANCE Weight lbs	Length ft	Diameter ft	Span ft	Range miles	Mach No.	Ceiling	PAYLOAD Type	Wgt lbs	REMARKS
AIR-TO-AIR																	
M-100	None	SR						990	13.0	0.9	3.0	5	1.3		HE	336	Train
M-100A	IR	SR	1000					85.5	4.43	0.26	1.0	5	2.65		HE	20	Op
Sidewinder Type	IR	SR						175	9.0	0.67	1.75	2 3	2.5		HE		Op
Type 1	IR	SR	8700					1000	15.0	0.95	2.5	5	2.5		HE	50	Op
Type 2	RD	SR	8700					1120	15.0	0.95	2.5	5.5	2.5		HE	50	Op
Type 3	IR	SR	8750					1250	15.0	0.95	3.0	5.5	3.0		HE	60	Op
AIR-TO-SURFACE																	
Hound Dog Type	RD	TJ							33.0	3.0	18.0	250 300	1.75		N		Op
Komet Medium Range	RD	SR							52.0	6.0	24.0	300	2.0		N		Op
Komet D	RA-RD	SR	15,000						15.0	3.0	8.0	93	1.1	50,000 ft	HE-N		Dev
RS-132A	None	SR							3.8	0.45	2.0		1.2		HE		Op Navy
Sky Bolt Type	RD	SR							30.0	5.0	8.0	500	2.5		N		Dev
BATTLEFIELD																	
140mm	None	SR						120	3.4	0.5	1.2	5.7	1.6		HE	55	Op
200mm	None	SR						428	10.4	0.9		11.5	2.4		HE	128.5	Op
240mm	None	SR						248	4.2	1.1		4.5	1.5		HE	108.5	Op
280mm	None	SR						1000	17.0	1.2	2.2	13.5	1.7		HE	483.5	Op
ME (Igor)	None	SR						10.5	4.0	0.41		2.25	0.7		HE	3.75	Op
T-5*	None	SR	8200	SR	2300	SR	440	4850	32.2	2.8	9.4	100	4.35	65,000 ft	HE	458	Train
		* Fourth Stage T-5 liquid rocket 83,500 lbs thrust															
IRBM								20,900	37.2	4.6	23.7	1450	1.15	10.25 mi	N	2200	Op Navy
J-3	RA-Prog	4SR	4000	RJ	14,900			37,850	62.0	5.6	12.0	600	7.0	132 mi	N	2650	Op Improved motor 78,100 lbs thrust
T-1 (M101)	RA-Int	LR	77,000														
T-2 (M103)	Int	LR	268,000	LR	78,100			122,000	65.5	8.5	17.0	1,800	13.1	120 mi	N	2240	Op
T-4 (M102)	Int	3LR	181,950	LR	52,800			70,850	56.1	7.2	14.0	1,000	11.15	227 mi	HE	1775	Dev Canx
T-10 (Komet 2)	Int	SR	99,000					41,350	42.2	5.9	10.9	620	7.5	195 mi	HE	550	Op Navy
ICBM																	
T-3 Mk 1 (M104)	RA-Int	3LR	480,000	2LR	270,000	LR	78,100	176,000	68.5	11.5	19.5	4950	20.0	570 mi	TN	2200	Canx
T-3 Mk 2	Int	3LR	480,000	2LR	270,000	LR	78,100	352,000	108.0	16.0	23.5	6500	20.7	576 mi	TN	2500	Canx
T-3A Mk 1	Prog	4LR	517,000	2LR	268,000			176,000	91.5	12.0	19.5	6200	21.5	960 mi	TN	1100	Op
T-3A Mk 2	Prog	4LR	820,000	2LR	268,000			396,000	101.5	16.0	23.5	6800	22.1	960 mi	TN	1250	Dev
T-4A	RA-Prog	4SR	264,000	LR	264,000	LR	77,000	231,000	122.0	10.2	63.8	12,500	19.5	235 mi	N	3CE0	Dev
SURFACE-TO-AIR																	
C-2	BR	LR	17,160					8400	25.8	2.85	8.1	25	2.0	50,000 ft	HE	675	Train
M-1	Int	3SR		LR				3300	15.0	2.0	10.0		1.5		HE		Train
M-2	SAH	SR	9350	SR	4625			3970	25.0	1.6	5.3	37.25	2.3	68,640 ft	HE	26.5	Op
T-6	RD	2SR	10,580	2SR	2200			3950	22.0	2.8	5.2	25	2.4	62,000 ft	HE	88	Op
T-7	RD	2LR	22,400					5050	30.1	2.6	9.1	60	4.4	100,000 ft	HE	407	Op
T-8	IR	2SR	4000	LR	4600			2090	13.6	1.05	4.8	15 25	2.5	79,280 ft	HE	50	Op
TACTICAL																	
T-5B	None	SR	22,000					5750	30.0	2.5	5.0	25	2.3		HE-N	1180	Op
T-5C	None	SR	23,200					6400	25.0	1.1	2.1	25	3.3		HE-N	1100	Op
T-7A	RA-Int	SR	11,450					8800	28.8	2.7	9.6	100	4.2	44.7 mi	HE-N	1770	Op
T-9 (Komet 1)	None	SR	53,250					20,250	36.8	4.26	10.9	102.5	4.25	42.3 mi	HE	460	Op
TARGET MISSILES																	
J-1	RA	2SR	2000	PJ	1825			9700	26.85	3.0	20 75	375	0.65	21,300 ft	HE	2650	Op Navy
J-2	RA	2SR	2000	TJ	4850			16,100	36.7	4.5	23.7	520	0.87	6.8 mi	HE-N	2200	Op Navy
POL-1	Prog	4SR	7990					2400	14.27	0.92			4.36		Inst	9.2	Op
POL-2	Prog-Int	4SR	90,650					25,950	25.6	2.3			7.12		Inst	90	Op
UNDERWATER																	
Golem 1	Prog	LR	121,200					33,125	53.8	5.5	11.2	395	7.0		HE-N	2100	Op Navy
Golem 2	Prog	LR	242,000	LR	71,500			74,800	56.9	7.2	13.2	1240	11.4		HE-N	1130	Navy IRBM
Golem 3	IR	4SR	14,950					4625	17.2	2.2	5.9	7.45	2.5	67,000 ft	HE	175	Op Navy
MISCELLANEOUS																	
Metro	None	SR	5000	LR	3020			2179	27.5	1.45	4.0		3.8		Inst	159	Sounding Rocket
Lunik I Booster	Int	3LR	480,000	2LR	270,000	LR	78,100	436,000	123.0	24.0	28.0				Sat	3245	Space Booster
		2SR	198,000														
Lunik II Booster	Int	3LR	480,000	2LR	270,000	LR	78,100	437,000	123.0	24.0	28.0				Sat	858.5	Space Booster
		2SR	198,000														
Lunik III Booster	Prog-Int	4LR	570,000	2LR	268,000	SR	99,600	352,000	105.0	30.0	30.0				Sat	614	Space Booster
		2SR	176,000														
																1 9,988	
																2 10,140	
Space Vehicle 1, 2, 3, 4, 5	Prog	4LR	820,000	2LR	268,000			700,000	127.0	16.0	24.0		21.5		Sat	3 10,039	Space Booster
																4 10,362	
																5 10,329	
Space Vehicle 6	Prog	4LR	820,000	2LR	268,000			850,000	137.0	16.0	24.0		21.5		Sat	10,395	Vostok I
Space Vehicle 7	Prog	4LR	820,000	2LR	268,000			880,000	137.0	16.0	24.0		22.0		Sat	10,408	Vostok II
		2SR	132,000														
Sputnik I Booster	RA-Int	3LR	181,950	LR	78,100	SR		156,000	105.0	12.2	14.0		27.6		Sat	183.9	Sat Launcher
		4SR	88,000														

DESIGNATION	GUIDANCE	POWERPLANT						SIZE AND PERFORMANCE							PAYLOAD		REMARKS
		1st Stage Type	1st Stage lbs/T	2nd Stage Type	2nd Stage lbs/T	3rd Stage Type	3rd Stage lbs/T	Weight lbs	Length ft	Diameter ft	Span ft	Range miles	Mach No.	Ceiling	Type	Wgt (lbs)	
Sputnik II Booster	Int	LR	268,000	LR	78,100	SR		185,118	79.0	17.5	17.0		28.1		Sat	1118.2	Sat Launcher
		2SR	106,500														
Sputnik III Booster	RA-Int	3LR	480,000	2LR	270,000	LR	78,100	180,000	118.0	14.0	22.0		28.1		Sat	2925.5	Sat Launcher
Sputnik VII Booster	Prog	4LR	820,000	2LR	268,000	SR	22,000	680,000	113.0	16.0	24.0		22.0		Sat	14,293	Unsuccessful V[illegible]s Probe
Venus Probe Booster	Prog	4LR	820,000	2LR	268,000	SR	22,000	680,000	113.0	16.0	24.0		22.0		Sat	1416.7	

ABBREVIATIONS

BR—beam rider.
Dev—development.
HE—high-explosive.

Inst—instruments.
Int—inertial.
IR—infra-red.
LR—liquid rocket.

N—nuclear.
Op—operational.
PJ—pulse-jet.
Prog—programmed.

RA—radio.
RD—radar.
RJ—ram-jet.
SAT—satellite.
SAH—semi-active homing.

SR—solid rocket.
T—thrust.
TJ—turbo-jet.
TN—thermonuclear.

APPENDIX B

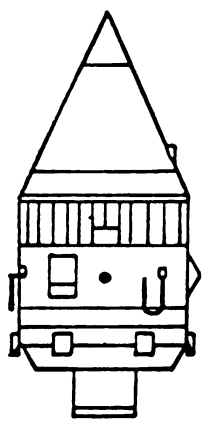
RUSSIA'S SPACE VEHICLES

SOVIET INTELLIGENCE REPORT

Reprinted by the Department of the Army with permission from AEROSPACE MANAGEMENT magazine, March 1962 issue.

RUSSIA'S SPACE VEHICLES

Since the late nineteenth century, when I. V. Meshcherksii and K. E. Tsiolkovski started their theoretical studies of using rockets to explore space, Russia has forged a determined path of progress. First practical rocket demonstrations began in 1933. By 1935, a broad competency was revealed by papers read at the All-Union-Conference on the Use of Rocket Devices for the Investigation of the Stratosphere. The Russian government was quick to recognize military potential of the rocket and space. A government sponsored research program was begun immediately, five years behind Germany, but eight years ahead of the Army-sponsored work in the United States. After WW II Russia was again quick to use German know-how and German technical personnel to set up a technology as it existed in Germany about 1945. Between 1949 and 1956 Russia moved quietly. Her scientists gave little indication as to what they were working on. Then, in 1956, at the First International Congress on Rockets and Guided Missiles in Paris, two papers were presented that revealed the prodigality of Russia's rocket program. In 1957, during the IGY, Russia launched the first instrumented package into Earth-orbit. What followed is detailed in the illustrations and data below.

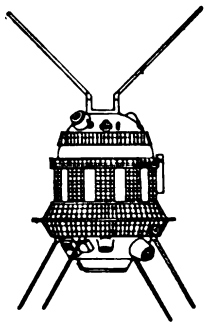


LUNIK I (Mechta)

Service: USSR Academy of Science
Type: Lunar Probe
Status: In orbit around Sun

Physical Data
Length: 18 ft
Diameter: 10 ft
Weight: 3245 lb

Remarks
IGY Designation—Artificial Planet 1. Launched 2 Jan 1959 and passed within 4700 mi of the Moon. Satellite carried a 797 lb instrument package. Was first successful deep space probe. Aphelion—123,250,000 mi; Perihelion—91,500,000 mi.

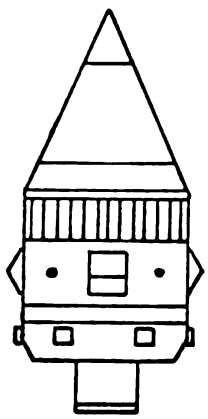


LUNIK III

Service: USSR Academy of Science
Type: Automatic Interplanetary Station
Status: Down 20 April 1960

Physical Data
Length: 4 ft 3 in.
Diameter: 3 ft 11 in.
Weight: 3416 lb

Remarks
IGY Designation — 1959 Theta. Launched 4 Oct 1959. Perigee—24,840 mi; Apogee—292,000 mi. Photographed the reverse side of Moon. Carried 344 lb of instruments in a 613 lb instrument container to measure radiation in space, moon's magnetic field, and micrometeorites.

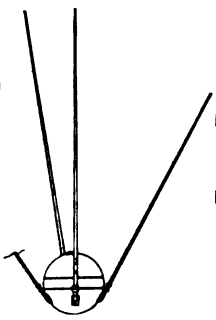


LUNIK II

Service: USSR Academy of Science
Type: Lunar Probe
Status: Impacted Moon 14 Sept 1959

Physical Data
Length: 18 ft
Diameter: 10 ft
Weight: 3324 lb

Remarks
IGY Designation — Lunar Probe. Launched 12 Sept 1959. Satellite carried 858.4 lb of instruments in a spherical capsule to measure radiation and magnetism.

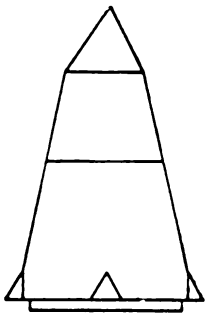


SPUTNIK I

Service: USSR Academy of Science
Type: Artificial Earth Satellite
Status: Down 4 Jan 1958

Physical Data
Diameter: 22.8 in.
Weight: 183.9 lb

Remarks
IGY Designation — 1957 Alpha. Launched 4 Oct 1957, Perigee—142 mi; Apogee—588 mi. Provided new information on density and temperature of the upper atmosphere.



SPUTNIK II

Service: USSR Academy of Science
Type: Space Flight Research
Status: Down 14 April 1958

Physical Data
Length: 8 ft
Diameter: 59 in. at base of cone
Weight: 1118.2 lb

Remarks
IGY Designation — 1957 Beta. Launched 3 Nov 1957, Perigee—140 mi; Apogee—1038 mi. Carried dog "Laika" and provided ionospheric, cosmic-ray, and biomedical data. No recovery of capsule attempted.

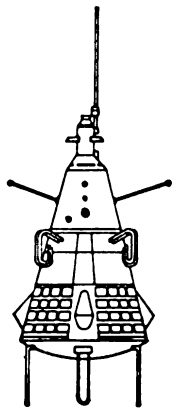
Configuration similar to Sputnik IV

SPUTNIK V

Service: USSR Academy of Science
Type: Spacecraft 2
Status: Recovered 20 Aug 1960

Physical Data
Length: 28 ft
Diameter: 8.7 ft
Weight: 10,140 lb

Remarks
IGY Designation — 1960 Lambda. Launched 19 Aug 1960, Perigee—189 mi; Apogee—210 mi. Capsule carried the dogs "Bielka" and "Strelka" in a pressure cabin, along with rats, mice, flies, plants, fungi, seeds. Reported to have been recovered during the 18th orbit.



SPUTNIK III

Service: USSR Academy of Science
Type: Earth Satellite
Status: Down 6 April 1960

Physical Data
Length: 11 ft 9 in.
Diameter: 68 in. at base of cone
Weight: 2925.5 lb

Remarks
IGY Designation — 1958 Delta. Launched 15 May 1958, Perigee—105 mi; Apogee—230 mi.

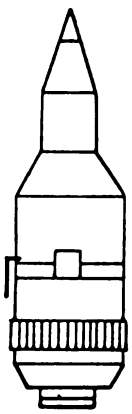
Configuration similar to Sputnik IV

SPUTNIK VI

Service: USSR Academy of Science
Type: Spacecraft 3
Status: Down 2 Dec 1960

Physical Data
Length: 28 ft
Diameter: 8.7 ft
Weight: 10,060 lb

Remarks
IGY Designation — 1960 Rho. Launched 1 Dec 1960, Perigee—116 mi; Apogee—165 mi. Capsule carried dogs "Pshelka" and "Mushka" along with other forms of animal and plant life. Capsule was tested for ultimate space flight by man. Recovery failed and capsule was burned up on reentry.

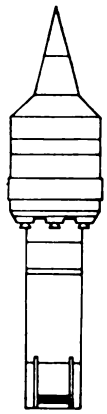


SPUTNIK IV

Service: USSR Academy of Science
Type: Spacecraft 1
Status: Down 26 Feb 1961

Physical Data
Length: 28 ft
Diameter: 8.7 ft
Weight: 9988 lb

Remarks
IGY Designation — 1960 Epsilon. Launched 15 May 1960, Perigee—188.5 mi; Apogee—228.7 mi. Booster placed space cabin with "dummy spaceman" in orbit to test life support systems. The pressure cabin weighed 5512 lb. Recovery failed.

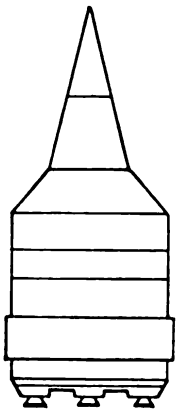


SPUTNIK VII

Service: USSR Academy of Science
Type: Deep Space Satellite Launcher
Status: Down 26 Feb 1961

Physical Data
Length: 36 ft
Diameter: 8.7 ft
Weight: 14,293 lb

Remarks
IGY Designation — 1961 Beta. Launched 4 Feb 1961 Perigee—138 mi; Apogee—203 mi. First Venus Probe, 3rd stage of booster failed to ignite and no separation occurred. 3rd stage propellent weight was 4520 lb and entire 3rd stage with satellite attached went into orbit.

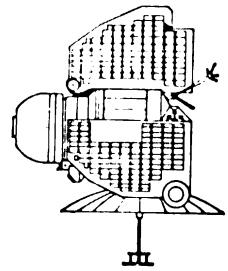


SPUTNIK VIII

Service: USSR Academy of Science
Type: Deep Space Satellite Launcher
Status: Down 25 [illegible] 1961

Physical Data
Length: 20 ft
Diameter: 8.7 ft
Weight: 9772 lb (includes the 1416.7 lb Venus Probe)

Remarks
IGY Designation—1961 Gamma 3. Launched 12 Feb 1961, Perigee—123 mi; Apogee—198 mi. SPUTNIK VIII satellite launched an "Automatic Interplanetary Station" toward the vicinity of the planet Venus while in Earth orbit.



VENUS PROBE

Service: USSR Academy of Science
Type: Automatic Interplanetary Station
Status: In solar orbit

Physical Data
Length: 80 in.
Diameter: 41 in.
Weight: 1416.7 lb

Remarks
IGY Designation — 1961 Gamma 1. Launched 12 Feb 1961 from SPUTNIK VIII while in Earth orbit. Planned to reach vicinity of Venus late May 1961. Now in orbit around Sun on a 300 day period.

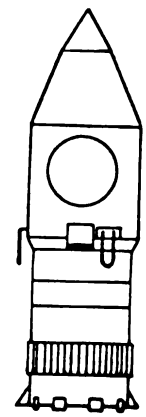
SPUTNIK IX

Service: USSR Academy of Science
Type: Spacecraft 4
Status: Recovered 9 Mar 1961

Physical Data
Length: 28 ft
Diameter: 8.7 ft
Weight: 10,362 lb

Remarks
IGY Designation — 1961 Theta. Launched 9 Mar 1961, Perigee—114 mi; Apogee—154.6 mi. Capsule carried the dog "Chernushka," guinea pigs, black mice, insects, plants and seeds on a single orbit of Earth. Capsule contained radio and TV equipment to relay information on the condition of the animals while in orbit.

Configuration similar to Sputnik VIII



VOSTOK I (SPUTNIK XI)

Service: USSR Academy of Science
Type: Spacecraft 6
Status: Recovered 12 April 1961

Physical Data
Length: 32 ft
Diameter: 8.7 ft
Weight: 10,395 lb

Remarks
Launched 12 April 1961, Perigee—112.4 mi; Apogee—203 mi. One Earth orbit with Major Yuri Gagarin as pilot of the space capsule.

SPUTNIK X

Service: USSR Academy of Science
Type: Spacecraft 5
Status: Recovered 25 March 1961

Physical Data
Length: 28 ft
Diameter: 8.7 ft
Weight: 10,329 lb

Remarks
Launched 25 March 1961, Perigee—115 mi; Apogee—155 mi. Capsule carried dog "Zvecduchka," some test animals and plants. Capsule was used to conduct further tests for manned space flight.

Configuration similar to Sputnik VIII

VOSTOK II (SPUTNIK XII)

Service: USSR Academy of Science
Type: Spacecraft 7
Status: Recovered 7 Aug 1961

Physical Data
Length: 32 ft
Diameter: 8.7 ft
Weight: 10,432 lb

Remarks
Launched 6 Aug 1961, Perigee—114 mi; Apogee—152 mi. Pilot Major Gherman Titov made 17 Earth orbits before landing. Capsule was equipped with a new type air regeneration system.

Configuration similar to Vostok 1

APPENDIX C

SATELLITES CARRYING EQUIPMENT FOR METEOROLOGICAL OBSERVATIONS

APPENDIX C

Satellites carrying equipment for meteorological observations

Satellite	Launch date	Date when data reception ended	Orbit inclination	Altitude in miles	Coverage of globe	Sensing equipment of meteorological interest	Area viewed and resolution	Types of observation	Remarks
Vanguard satellite launching vehicle 3.	Sept 26, 1958	Did not orbit.	Did not orbit.	Did not orbit.	Did not orbit.	2 infrared photocells.	(1)	Roughly map cloud cover.	Did not orbit.
Vanguard II	Feb. 17, 1959	Mar. 7, 1959	32.88°	347 to 2,064	33° N. to 33° S.	2 photocells sensitive to visible light.	Area, 6 to 30 miles	Roughly map daytime cloud cover.	Wobble made data too difficult to interpret.
Explorer VI	Aug. 7, 1959	(1)	48°	156 to 26,357	(1)	Elementary scanning device.	Low resolution	Took first sketchy TV-type pictures of Earth.	1 picture assembled and released; little meteorological value.
Explorer VII	Oct. 13, 1959	Oct. 13, 1960	50.3°	342 to 680 (800?).	50° N. to 50° S.	6 radiation sensors (Suomi's experiment).	(1)	Solar, reflected, and reradiated infrared radiation for thermal radiation balance.	Data for research.
TIROS I	Apr. 1, 1960	June 29, 1960*	48.3°	430 to 468	do	Wide-angle TV camera.	Area, 700 to 800 miles. Resolution, about 2 miles.	Daytime cloud cover	Research; some operational use.
						Narrow-angle TV camera.	Area, 70 to 80 miles. Resolution, about ¼ mile.	Snow and ice cover	Research.
TIROS II	Nov. 23, 1960	Suspended remote wide-angle camera operation, Jan. 18, 1961. Final cutoff Dec. 3, 1961.	48.5°	387 to 453	do	Same cameras as TIROS I.	Same as TIROS I.	Same as TIROS I	Research; some operational use. Wide-angle camera out of focus.
						Radiation sensors.	450 miles	Thermal radiation balance.	Research.
							30 miles	Temperature of Earth surface and cloud tops. Temperature and water vapor variation in tropopause.	
						2 wide-angle cameras.	About 2 miles	Daytime cloud, snow, and ice cover.	
TIROS III	July 12, 1961	Operating	48°	460.75 to 506.82.	do	Explorer VII-type radiation sensors. (Suomi).	About 450 miles	Thermal radiation balance.	Camera No. 1 inoperative.
						2 radiometers	30 and 300 miles	Radiation in specific wavelength bands	
TIROS IV (2 more planned).	Feb. 8, 1962	Operating	48°	475 to 500	do	Same as TIROS III except new lens on one wide-angle camera.	New lens. Area, about 450 miles. Resolution, about 1.5 miles.	Same as TIROS III	
						Improved TV cameras.	Area from horizon to horizon. Resolution, about ½ mile.	Greater detail of daytime cloud, snow, and ice cover.	
Early Nimbus	Proposed for 1962–63.		80° (retrograde).	600 (600 nautical).	Entire globe twice a day.	Radiation sensors.	300 miles	Thermal radiation balance.	
							30 miles	Temperature of Earth's surface or cloud tops and others.	
							5 miles	Limited solar spectral measurements. Nighttime cloud cover.	
Later Nimbus	Proposed for 1964–70.					Radiation sensors.	(1)	Partial temperature soundings of cloudless upper troposphere and stratosphere to obtain temperature structure. Time variations in solar spectra. Vertical distribution of water vapor, ozone, carbon dioxide.	
						Radar	(1)	Detection of precipitation areas; possibly height, type, and vertical structure of clouds.	
						Sferics	(1)	Detection of thunderstorms.	
Aeros	Proposed for 1968.		"Stationary" over Equator.	22,300	60° N. to 60° S.[2]	Stationary TV cameras.	Resolution, 1 to 3 miles.	Daytime cloud cover	With 4 satellites, nearly continuous daytime cloud cover.
						Movable TV camera.	Resolution, ¼ to ½ mile.	Specific weather system under surveillance.	
						Possibly infrared camera.	(1)	Nighttime cloud cover	

[1] Not available.
[2] Partial coverage up to 63°. Nearly continuous global coverage with 4 Aeros satellites. (Between 60° N. and 60° S.)
*Useful data; one beacon still continues weakly.

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APPENDIX D

SPACE RACE TIMETABLE FOR THE COSMIC SIXTIES

APPENDIX D

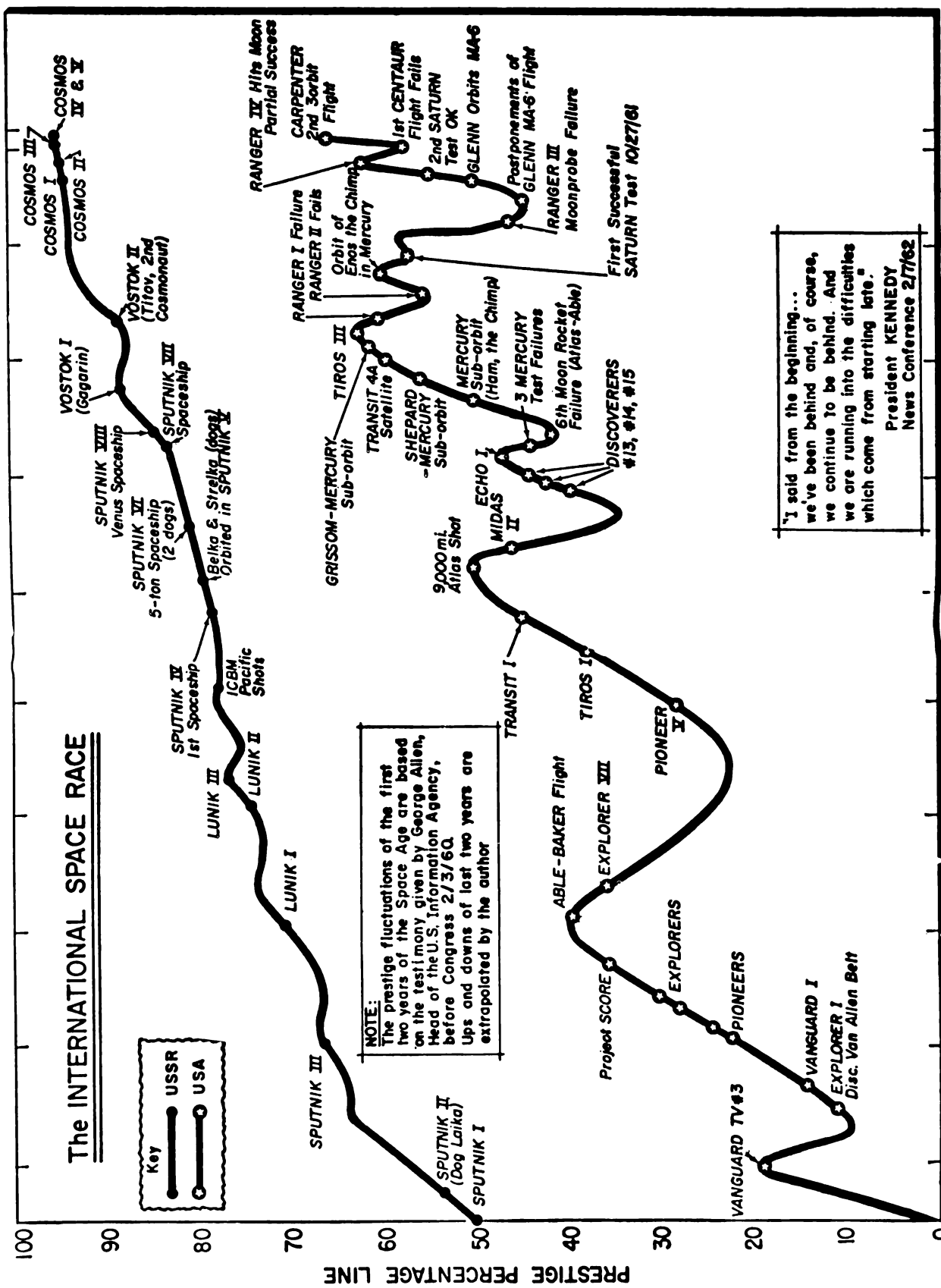
Space Race Timetable for the Cosmic Sixties

Year	*U.S.A.**	*U.S.S.R.†*
1962 (late).	*Ranger* unmanned moon probe in fall. *Mariner* shot to Venus in early fall. Manned *Mercury*—seven orbits	More cosmonauts around the earth First Soviet weather and communications satellite More probes to the moon and around it
1963–64...	'63 *Nimbus* advanced weather satellite. Twenty-four-hour *Mercury* earth orbit. First *Gemini* flights. *Rangers*—additional hard landings on the moon '64 First of seven *Surveyors* for soft moon landings. First Orbiting Astronomical Observatory. Unmanned reconnaissance of Mars and Venus. First *Gemini*—two-man earth orbit rendezvous practice with *Agena*. First X-20 *Dyna-Soar* test flights	First one-way freight rocket shipments to the moon—unmanned—including radio beacon and equipment for constructing bases Landing of dog on the moon Manned circumlunar flight
1965–66...	More *Surveyors* soft landing on the moon sending back data. First *Aeros*—22,300-mile synchronous weather satellite. More *Mariners* to probe Mars and Venus. First flight test of 1,500,000-pound-thrust F-1 rocket engine. More active communications satellites	One-way manned expedition to the moon, with additional freight rockets to support permanent base
1966–67...	'66 Unmanned *Apollo* sent into circumlunar orbit. First flight test of *Rift* nuclear rocket engine. Voyager satellite to Mars and Venus '67 Manned *Apollo* to lunar orbit	Retrieval of first lunar expedition and replacement with new crew Lunar colony started Manned space station in 21,000-mile earth orbit
1968–69...	Manned *Apollo* lands on moon and returns after three to six days. Operational status for first global communications satellite system—for TV, telephone, radio	Possible animal probes of planets Mars and Venus on one-way or round trips

* Based on official NASA estimate.
† Based on Soviet scientific statements.

APPENDIX E

THE INTERNATIONAL SPACE RACE



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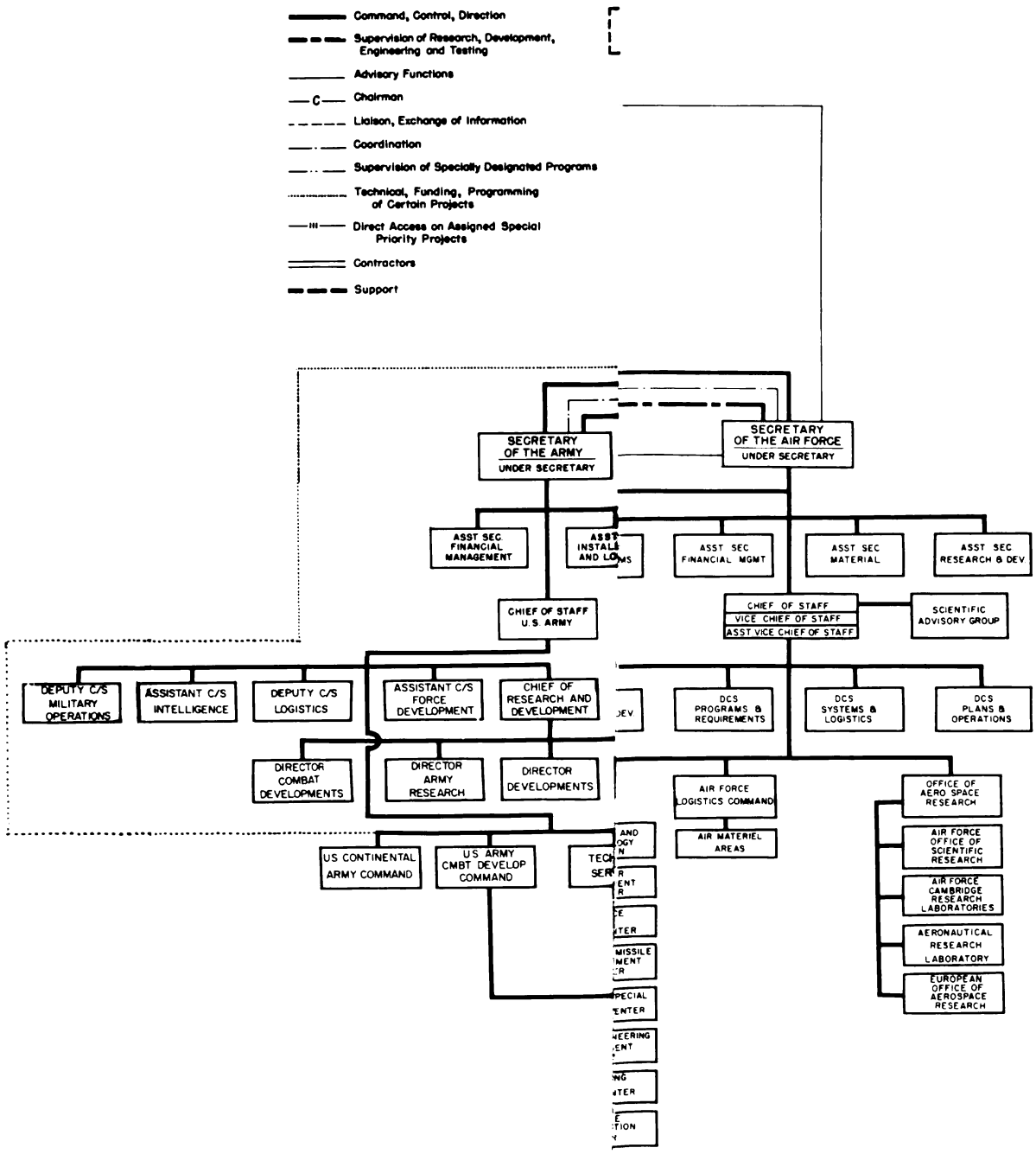
APPENDIX F

UNITED STATES SPACE AND MISSILE PROGRAMS: FUNCTIONAL ORGANIZATION OF THE FEDERAL GOVERNMENT



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Revised as of Feb. 1, 1963

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EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:

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